THE

AMERICAN

JOURNAL OF SCIENCE AND ARTS.

[SECOND SERIES.]

ART. I.—*Evidences of Glacial Action on the Green Mountain Summits;* by EDWARD HUNGERFORD.

THERE are in Vermont five peaks belonging to the Green Mountain range, which rise to an elevation of more than four thousand feet. In the order of position, commencing on the north, we have first Jay Peak, 4018 feet; Mount Mansfield, 4430 feet; Camel's Hump, 4088 feet; Lincoln Mountain or Potatoe Hill, 4078 feet; and Killington Peak, 4221 feet above tide. The elevations are given on the authority of Prof. Guyot.

In my recent excursions to several of these summits, I have been able to study the evidences of glacial action at those elevations, and to accumulate a number of observations, beyond those which have been alluded to by others; so that we are now placed in a situation to review and sum up the principal facts, bearing upon the question of the height to which such action has extended in this state, and upon that of the probable thickness of the accumulation of ice and snow in the glacial epoch.

The attention of the earlier geologists of the State was prominently directed to the drift phenomena, and, in speaking of the elevation to which "drift furrows" extend, Prof. C. B. Adams remarks: "They exist abundantly on Jay Peak .... The furrows were found a few yards east of the highest westerly point, and six or eight feet below it, and were continued over the east part of the Peak with a direction from north 40°

west,* as nearly as could be determined over a talcose slate which abounded with crystals of magnetic ore."†

Mount Mansfield presents a long elevated ridge, which attains, in the Chin, its greatest elevation of 4430 feet, while the Nose, at the southern extremity of the ridge, rises to the height of 4094 ft. above the sea. The evidences of glacial action around the summits of this ridge are very decided. The grooves mentioned in the final report of our State Geologists, in close proximity to great transported blocks under the Chin, at an elevation of about 4080 feet, are well preserved, and I was able to obtain the following corrected readings of compass, indicating the direction of approach of the glacial mass, viz: N. 23° W., and N. 25° W., (two readings on the same line), also N. 28° W. on another furrow. One of the transported blocks, 25 feet long, 15 feet wide, and 11 feet high, was doubtless torn from another portion of the mountain, and its present position, as it lies perched upon and supported by another smaller boulder, indicates that it had been first lifted, and then had settled down into its resting place. The surface of the rock in situ, under the great boulder, is rounded, so as to denote an erosive action, previous to the deposition of the mass upon it. A fine stereoscopic view of this boulder, under the name of the "Drift Rock," is sold by A. F. Styles of Burlington. Very distinct groovings are also found on the eastern slope of the ridge, only about fifty or one hundred feet below the mountain house, directly in the bridle path that leads to Stowe. These furrows are estimated to be about 3800 feet above the sea, and correspond in their general direction with the furrows observed on the western face of the mountain near the boulders described above.

A very beautiful evidence of glacial action is furnished by the polished knobs of quartz, on the top of the Nose, at an elevation of 4094 feet. Numerous such quartz masses are found projecting from the matrix of the rock, and these are often very smoothly and handsomely polished. In a good light, fine striations are visible upon these knobs, as is shown in a small hand specimen brought by me from this locality.

On the summit of Camel's Hump, which rises 4088 feet above tide, the principal evidences of glacial action, consist in the polishing of the quartz knobs and the rounding of the sides of cliffs, the former being observable upon the summit itself, and the latter having been traced to within some fifty or one hundred feet at least of the highest point. No grooves or furrows,

* True bearing. The readings of compass given in this article are all corrected readings, 10° western variation being allowed.

† Second Annual Report on the Geology of Vermont, by C. B. Adams.

except the fine lines upon quartz, were found upon the summit, although extended search was made for them. The preservation of such furrows in the extremely friable rock must be rare, though they may yet be detected in the immediate vicinity of the summit on some freshly exposed surface. The rounding of the cliffs, upon the northern side of the final ascent, within the above named distance of the highest point, is so conspicuous as to at once attract attention. The highest level at which distinct grooves were observed is judged to be about 700 feet below the summit, or nearly 3400 feet above the sea. At this point, in the bridle path which descends the northern or northeastern face of the mountain toward Ridley's Station,* in the Wooski Valley, the bearing of the grooves was N. 20° W. and again N. 40° W., the latter being on a side of rock and deflected. The ledge at this point was handsomely polished. The course of the moving ice on this stossward flank of the mountain, was undoubtedly determined, in part, by the barrier which the mountain itself presented to its progress.

The evidence of glacial motion afforded by the polished quartz knobs, both on Mount Mansfield and on Camel's Hump, is of such value as to require some special notice. These smoothed massses of quartz I have examined on both mountains, and from both localities I have brought away small specimens for closer inspection. That from the top of the Nose, on Mansfield Mountain, retains very distinctly the fine, sharply cut, glittering hair-lines, which were graven upon it by the fine grit of the glacier, or by points of hard mineral frozen into the moving mass.

The specimens from Camel's Hump were less distinctly striated, the lines not having been so sharply cut, or not so well preserved. But, in these also, the direction of the polishing motion is very readily detected from the general character given to the surface by the minute gravings. In order to test this point, and to correct any possible influence of habit, or of prejudice in myself, I invited my host of the Mountain House, who was unacquainted with such observations, to determine independently the direction of the polishing force. His determination coincided with my own. The directions as determined upon the mountain were marked upon the masses in pencil before breaking them off from the rock, and the observations confirmed by careful examinations at home. The lines are much more distinctly brought out by moistening the surface.

* The point on the Vermont Central R. R. from which the ascent is made.

In the absence of other indications of glacial action, such masses are valuable for determining the former presence of such an agency, and the direction of the moving force.

The bearings taken upon the summit of Camel's Hump and based upon these determinations on quartz knobs, differ materially one from another. I obtained the following corrected readings at different points on the summit. In one instance N. 10° E., in another N. 10° E. to North, and in a third N. 35° W. The two former bearings were taken at points toward the northern side of the summit, the last at a point somewhat more sheltered from a force of northern origin. These variations in direction seem to me to indicate that the glacial mass, as it enveloped this peak, flowing over and around it, had its partial motions entirely governed by the rocky obstruction, while the general current of the glacier maintained its course. Must not the slow motions of such a glacier conform in this respect, as well as in others, to the law governing the flow of water; that, while the main current keeps its course, the subordinate and local currents are directed along and around every considerable obstruction in the way of the stream?

Killington Peak rises 4221 feet above tide. Its bare summit of gneiss, twelve miles back, or eastward from Rutland, is easily reached, and well repays a visit. I observed no striations upon this mountain; no quartz knobs projecting conspicuously from the rocky matrix, and retaining distinct traces of glacial motion. The sharp terminal peak is much torn by frost and lightning, so that one clambers to the top over a steep talus of fallen masses. There is, in the last twenty feet of the elevation, a pretty well defined northern stoss side, and, over this part of the peak, the rounding off of the rock is sufficiently well marked. The point of most interest, however, in connection with Killington Peak, is the occurrence of numerous, small, well rounded boulders of foreign rock upon an offset within twenty feet of the highest point. The most conspicuous of these, perhaps, are of quartz rock, varying in size up to a foot or a foot and a half in diameter. They are well rounded, and were traced all along the higher portion of the mountain up to this point. The material of these boulders or pebbles differs in its character, that of a true granular quartzite, from the hyaline quartz contained in the gneiss of the summit. These are true transported pebbles, lifted to this elevation from some lower point, probably from the quartz range to the northwest. With the quartzite pebbles are also found pebbles of gneiss, with rounded edges, and of a very

different character from the gneiss constituting the summit. The home of these gneiss pebbles is not known to me.

It will be seen from this survey of the elevated peaks of the Green Mountains, that they present in every instance, where an examination has been had, decisive marks of glacial action around their extreme summits. The conclusion follows that those summits have been enveloped by glacial ice, which must have been in each case either the beginning of a glacier descending from the summit, or else a part of an extended ice mass, moving over the entire surrounding country. Against the former supposition might be adduced the form of these mountains, which, in every instance except that of Mount Mansfield, is that of a single isolated peak on which no gathering places for large masses of snow offer themselves, as also the fact that their rounded slopes point uniformly in the case of those I have visited, Mansfield, Camel's Hump, and Killington, to the northward, while abrupt precipices face southward and eastward. Still more conclusive on this point is the presence of quartzite boulders on the summit of Killington Peak, which have had their origin in remote beds at a lower level.

ART. II.—*Notes on the Quicksilver Mine of Santa Barbara, in Peru.* Condensed from a MSS. Report made to the New Almaden Quicksilver Co., by C. E. HAWLEY, M. E.

THIS mine, which has been worked since 1570, is situated on a bold promontory or Farallon in the summit of the range about 1200 feet above and on the south side of the river Huancavelica. The strata containing the cinnabar rise almost vertically from the valley, being light-colored sandstone, with occasional layers of bluish-gray limestone. The metalliferous stratum spreads out in places to a width of forty or fifty yards, running N. and S., and dipping westerly. The mine, which is naturally a very safe one to work, has been so carelessly and ignorantly opened as to have led at various times to extensive ruins and great loss. The present condition of the mine is deplorable, owing principally to the reckless system of the last lessor, who robbed the mine of every pillar, and like his predecessor made no new works to open fresh bodies of ore. In St. Domingo de Cochapata, in the bottom of the mine, over one hundred Indians were buried at one time.

In 1681 the ore which fell in the "labores" of the San Jacinto, and was afterward extracted, produced four thousand flasks of quicksilver. The crush in 1786 from the falling in of

the upper "labores" of Santa Rita, left a yawning chasm 200 feet deep. The repairs of these damages during the working of the Santa Barbara mine have amounted probably to several millions of dollars. This has occurred in a mine safer and easier to work by far than the New Almaden in California. Extravagant sums have been expended on the great tunnels of this mine; that of Belen cost the Spanish Government nearly a million and a quarter of dollars.

Since the Peruvian Independence, but little attention has been bestowed on this mine, which, after 300 years, is now abandoned to a few Indians who collect and reduce small quantities of ore from the superficial works. Most of the great works are closed by caving, or by the accumulation of carbonic acid gas. The grand tunnel is about 2000 feet long and from ten to twelve feet wide and high, connecting with an incline-tunnel about five feet wide and high, running down at an angle of 15° to the ore. Omitting many details of the ancient workings now for the most part clogged or irreparable, it appears from the evidence of the explorations that the bodies of ore have not occurred in regular vein-like or continuous masses, as at Almaden in Spain. The ore of the "labor" of Santa Inez, fully twelve feet thick and extending probably 150 feet to the "labor" of Santa Cataline, consists of a base of dark colored sandstone spotted in places with bright red particles of cinnabar and again containing cinnabar invisible to the naked eye. Large quantities of sulphuret and sulphate of iron occur in connection with the ore, which rarely contains so much as two and a half per cent of mercury. Large bodies of iron pyrites are said to have been left standing in the lowest depths of the mine, which, if worked, would probably yield more mercury than the average ore of the mine. The lowest point the author was able to reach was evidently the beginning of the large bodies of ore of the mine.

Leaving the mine on the side of the grand tunnel he examined the bold promontory of sandrock overlooking the city and river of Huancavelica, and marking the extreme north end of the workings of Santa Barbara. This is an immense body of stratified rock of about fifty yards thickness running north and south and standing nearly vertical. A portion of it, averaging about one-third of the whole, is impregnated with cinnabar of very poor quality. About two hundred yards south of its summit is the point called the Brocal, and to the south of the Brocal, a short distance, the strata bury themselves below the surface to re-appear again only at a distance of about fifteen hundred yards. The whole body of the mine at the Brocal is one vast ruin, and the percentage of the surface ore is too low

to make it valuable. A deep tunnel, commenced during the past century, and extended about 200 yards from the foot of the promontory, but still six hundred yards from the old workings of the Brocal, is the only mode of developing these beds in depth where tradition tells of rich and extensive bodies of ore.

Extensive workings running to the westward are approached by the Puerto de Santo Domingo, standing midway between the promontory and the Brocal. Here are numerous large chambers rapidly going to ruin, excavated in a light-colored sandstone containing cinnabar in minute quantities, amounting to less than half of one per cent. In the same strata with the Santa Barbara, and in close proximity, are six or eight other mines belonging to private individuals, formerly productive but now abandoned.

In the vicinity of Huancavelica there are no less than forty-one well recognized ranges of cinnabar, all within eighteen leagues of St. Barbara. Thus at Azulcocha, one and a half leagues south of Santa Barbara, there is an extremely hard vein of cinnabar in limestone formerly mined, and where the ruins of old furnaces are still to be seen. The ore occurs in small branches and painted surfaces without regularity, and yields an average of not over one per cent. Near this is another vein of realgar containing also mercury, and about five feet in thickness. Immediately adjoining the realgar is a vein of a black sooty material of about eleven feet thickness. It appears to be a decomposed sulphuret, but its characters are obscure. This vein is remarkable from its containing selenium, associated with sulphur, mercury, arsenic, silver and lead.

The ores of Santa Barbara mine are all poor, not averaging probably over one-half of one per cent. The ore is frequently quite invisible and is disseminated through the rock at times in feebly developed veins a few lines in thickness, but generally without any vein form whatever. There are ores in the lower portions of the mine in which the cinnabar is invisible, but generally the appearance is that of common sandstone with very small particles of a bright red color scattered through its mass. Crosmin, a French engineer, describes the same stone as intimately mixed with arsenical pyrites. Such ore contains more mercury than the simple sandstone. As much realgar is found in the St. Barbara mine as in all the other quicksilver formations of Peru. The arsenical mercury ores were rejected by the miners, because of the effects of the arsenic in the furnaces. Sulphate of barytes both in crystals and closely mingled with siliceous grains occurs in the mine. Large quantities of iron pyrites are also found, much of which might no doubt be profitably worked.

The deposit of cinnabar at St. Barbara is not in a vein, as at New Almaden, but is disseminated through the strata, and intimately mingled with the sandstone. No walls exist, and the limits of the ore are irregular and undefined. Like all other similar formations the quantity of ore is very great and the quality very poor.

The furnaces used in reducing the ores were of stone and brick, poorly constructed, and the vapors were conducted through aludels or earthen jars joined end to end and leading from the upper part of the furnace, a distance of from eight to ten yards, where the smoke and vapor escape into the open air. These aludels are about two feet long, by a middle diameter of eight inches, and four inches at the ends. Four lines of them lead from each furnace, lying side by side upon the ground. The furnaces and condensers are of poor materials, the openings imperfectly closed, and the firing badly conducted, so that great losses of quicksilver occur and the workmen suffer from the poisonous vapors. The fuel is of dried grass and the dry dung of the Llama, both scarce and almost valueless as fuel, the quantity consumed to produce a feeble effect being very great. The country is completely without wood, except in a few deep ravines where some stunted bushes grow, worth about $20 a cord, equal to 145 Llama loads. None of it exceeds three-fourths of an inch in diameter. There is some turf, better in quality than the other fuels, but insufficient to maintain a large metallurgical operation. The author searched the country for ten leagues about Sta. Barbara for coal, but in vain. A very poor quality of bituminous slate exists in considerable quantity about nine leagues from Santa Barbara, but aside from its low quality, the distance of mountain roads precludes its use. The history of this mine shows extreme difficulty from the want of fuel, and even stoppages for several months at a time.

The author considers at length the questions of labor, quicksilver lost in reduction, and markets and transportation of quicksilver, giving much curious information of an economical nature, which our space excludes.

In conclusion, it appears that the St. Barbara district in Peru is extensive, the mercurialized sandstone being practically inexhaustible in quantity, but the grade of ore very low, not over one-half of one per cent, and the richest portions not averaging over 1½ per cent. The records of the mines have been very loosely kept, and offer no reliable data. The furnaces are remarkable for their worthlessness, which is still more true of the fuel. A system of concentration of the poor ores by machinery and water, which is in unlimited quantity, was proposed by Baron Nordenflycht, which deserves serious attention.

The labor at Sta. Barbara is necessarily Indian, and very inefficient, the extreme rarity of the air at an elevation of 14,975 feet above the sea (according to Ulloa) adding to the natural inefficiency of the race. Great numbers of Indians formerly were employed in these mines. In 1621, there were 2,000 Indians, who were required by government edict to produce 3 quintals (4 flasks) of quicksilver for each Indian per annum. "His majesty pays for the same, $47 per quintal." In 1681 the cost of quicksilver to the government, including transportation to Potosi, was $79 per quintal, and in 1678, its value at Potosi was $97 per quintal. In 1789 the cost rose to $195 per quintal, so that the king lost that year $197,758, and in five years, $693,624. In 1681, and for some years about that time, the average product was 7,500 flasks per annum, with 4,249 Indians at work. At New Almaden nearly six and a half times that quantity of quicksilver has been extracted in a single year by less than a thousand men. B. S.

ART. III.—*Notes on the Quicksilver mines of Almaden, Spain.* Condensed from a MSS. Report made to the New Almaden Company of California, by C. E. HAWLEY, M. E.

THESE mines, which, according to Pliny, were worked 700 B. C., and in his time annually sent 10,000 pounds of cinnabar to Rome,* are still productive to a remarkable extent.

The geological position of the Almaden mines has been shown to be Upper Silurian by the researches of Don Casiano de Prado, the predominating rocks being slates which usually form the walls of the veins and are sometimes impregnated with cinnabar. The matrix or gangue stone of the ore ground is a hard fine-grained sandstone, so hard at times as to be confounded with quartz. These sandstone beds form the so-called veins, and appear to have been impregnated with the vapors of cinnabar at the time of their metamorphosis, and so evenly are they charged with the ore, that in mining very little waste rock is taken out. There are three veins of ore at present worked in this mine. 1st, the San Diego and San Pedro; 2d, San Francisco; and 3d, San Nicholas. These are separated by masses of slate and sometimes enclose thin layers of slate in the ore. The linear extent of the mine is only about 600 feet, and near the surface, was much less. The mine is divided into ten different floors or levels, separate from each other by an average of about 90 feet, the lowest level being 921 feet from surface.

* Pliny, lib. 33, chap. 7.

The veins in the upper workings appear to have been very indistinctly defined, but have increased in power and in quality of ore steadily as greater depths have been reached. They were fully developed in their true character only on the 5th floor, while now in the bottom of the mine at the 10th level the richness and abundance of the ore in sight exceeds all before known. The following tabular statement illustrates this progressive increase in the extent and width of the three veins at the several levels commencing with the fifth.

	San Diego.		San Francisco.		San Nicholas.	
Level.	Length.	Width.	Length.	Width.	Length.	Width.
5th,	164′	14·5′	426′	13′	98′	9·6′
6th,	264	16·5	363	49·5	214·5	10·7
7th,	495	15·3	511	15·3	412	13·2
8th,	561	26·4	594	14·5	610	18·1
9th,	495	21·5	478	9·1	561	9·2

The 10th level is not yet sufficiently worked to determine the length or thickness of the veins, but the ore is of fine quality. The veins stand nearly vertical and are opened by vertical shafts. Their course is in general N.W. and S.E., and they are separated from each other by slate and sandstone. The linear extent of these veins is far from being completely proved. Work has been suspended where the ground became comparatively sterile. But it is well known that the mine, extensively opened in the 17th century by the Fugger Counts, exists in close proximity on the N.W., while a few yards of exploration in that direction, or to the S.E., may show the veins restored to their fruitfulness. The great mine worked by the Fuggers, and after them until the great fire of 1755, though in close proximity to the present mine, is now unknown, although the records prove its great yield and that it was worked to a depth of 825 feet.

The mode of extraction of the ore with the securing of the mine is by leaving alternate pillars of the solid ore 4 varas wide, the space left void between which, after the ore is removed, is filled by masonry, or by broken stones supported upon arches of masonry. The galleries of the mine are also turned in masonry. This system was adopted in 1804 on account of the scarcity of timber and with a view to the greater permanency of the work. The reserves of ore thus accumulated, equal nearly to all that has been removed, have been left untouched since 1804 until within the past 6 years, since which time very limited quantities of them have been removed, the spaces left being filled with much less care than the first set of pillars. Timber is used only for temporary purposes; the stone required for the masonry being quarried in the adjacent hills.

The mechanical appliances of this great mine are of the most primitive description. The ore is raised through the Teodoro shaft by 8 mules working a whim with an effective force of about 3 horses (steam standard). The amount of water in the mine is very small and appears to have varied but little in a century. The system of pumping is slow, expensive and barbarous. An antique machine of the last century, notable only for its age and inefficiency, demands for its aid the constant additional force of 30 to 40 men employed in pumping by hand.

The cost of extraction of the metric quintal of 100 lbs. of ore is as follows, given in reals (=5 cents U. S. coin.)

Excavation in ore and dead ground	7·40 reals	
Interior transportation	1·24 "	
New timber, refuse rock, etc.	0·55 "	
Tools, 0·92, whim, shops, etc., 1·17	2·09 "	
Rock for fortifying mine, 1·57 mortar and brick, 1·02,	2·59 "	
Masonry, 1·25, timbering, 3·67, carpentry, 1·11	6·03 "	
Draining the mine	4·47 "	
Laborers at mine, shaft, yard, etc.	2·86 "	
Various expenses, 0·78, salaries, 1·48	2·26 "	
		29·49
Transportation to furnaces,	0·17 "	
Cost of metric quintal of ore at furnace,		29·66

This is equal respectively to 67·8 c. and 68·2 c. of U. S. coin.

Much doubt seems to rest over the amount of metal obtained from the ore and respecting the relative merits of various modes of distillation. The most trustworthy observations, however, appear to be those made between 1851 and 1855, from which the average per centage obtained was 6·9, at the following cost per quintal (100 Spanish pounds.)

Mining and transportation	197·65 reals.	
Cost of reduction in furnaces	22·35 "	
Flasks	40·00 "	
		260·00

equals $13 U. S. coin per quintal, or $9.75 per flask, which sum is however raised to $15·15, including cost of transportation to Seville and various incidental expenses. The average product of the five years named for both Almaden and Almadenejas we find at 16,582 quintals (=22,199 flasks), which cost in the aggregate $304·535, or $13.77 per flask. If the expenses and product of the Almaden mine are estimated separately, (Almadenejas being a small mine, raises the ratio of cost considerably), it is seen that its average annual yield was 21,468 flasks, costing $268,214.53, or $12.49 in Seville. This cost is apportioned as follows.

Mining, per flask,	$6.53	or 52·25	per cent.
Reduction, "	0.87	" 6·96	"
Flasks, "	1.50	" 12	"
Flasking, "	0.09	" 0·75	"
Transportation to Seville,	.70	" 5·64	"
Administration,	2.58	" 20·65	"
Extraordinary, etc.,	.22	" 1·73	"
Total per flask,	12.49	100·00	

In the aggregate these expenses appear as follows, viz:

Administration,	$8,188
" superintendence, clerks, firemen, etc.,	21,117.80
Expense of warehouse at Seville,	2,459.50
Materials of shops,	1,121.85
Mining (less administration),	133,086.95
Reduction (furnaces),	17,544.20
Flasks, flasking and transportation,	39,951.70
Commission,	36,171.30
Transportation of funds, etc.,	1,880.55
Rents, $189.95, charities, $497,	684.95
Extraordinary and unforeseen,	4,687.75
Daily ordinary accts. of storehouses,	290.90
Hospital and church,	2,291.00
Laboratory,	160.00
	$269,636.45
Deducting $2680·05, the profits of Almadenejas,	2,680.05
And the remainder of	$266,956.40

very closely corresponds with the sum of $268,214.55, the cost of 21,468 flasks at $12·49 each.

The Bustamente furnaces in use at Almaden are extremely defective, depending on a series of small earthen ware cylinders, joined one to another and leading into a large chamber for the condensation of the mercurial vapors. Much mercury is lost from leaks in the joints of this apparatus.

In 1856 extensive and careful assays were made by two engineers employed by the Spanish government, of the ores accumulated for the burning of that year. The following deduction was made of the value of the different qualities of ore.

Metal or superior mercury,	38·576
Mediano (medium)	9·9
Bolas (cakes) of fragments of soot from condenser,	17·790
Bolas without soot,	5.110

Applying these figures to the five years, the results would be as follows, viz:

38,551 quintals	"metal,"	= 38·576 p. c.	= 14·872 quintals	mercury.	
143,969 "	"mediano,"	= 9·904 "	= 14·239 "	"	
5,109·5 "	bolas with soot,	= 17·79 "	= ·908 "	"	
45,985·5 "	bolas without soot,	= 5·11 "	= 2·349 "	"	
	Total quintals,		32·368		
	" " obtained,		16·101		
	Loss,		16·267.		

This loss of 50·25 per cent is equivalent to 21,689 flasks; or, the ore contained, by the above estimate, 13·86 per cent and the amount of mercury obtained was 6·96 per cent.

Notwithstanding the cheap labor at Almaden, many items of cost are extravagantly high; at 78 cts. per ton of water raised, the enormous sum of $17,541 is expended in pumping by hand! At least one-third the effective force of the mine-laborers is wasted in the toil of climbing up and down from the entrance to the bottom of the mine, want of ventilation making an additional heavy tax on the productive power of the miners. The cost of fuel for the furnace is extravagantly high and its quality the poorest.

The great feature of this mine, in contrast with other mercury mines, is the enormous body of rich ores always in reserve and ready for immediate extraction. A careful measurement shows that 36 per cent of the vein has been left untouched, equal to 2,012,600 cubic feet, which upon a moderate estimate must weigh 402,520,000 lbs. This at 7 per cent would give 375,685 flasks of quicksilver; at ten per cent it would yield 536,693 flasks, and at 14 per cent, 753,370 flasks of 75 pounds each. This estimate makes no account of the great body of extremely rich ores existing untouched between the 9th and 10th floors of the Almaden mine.

The very heavy expenses of fuel, pumping, transportation, hoisting of ores etc., might easily be reduced to at least one-half their present cost. Good coal exists in the great coal fields of Belmez, only 40 miles from the mine. With a safety cage for raising ore and the operators, good ventilation and drainage, and a proper system of railroads above and under-ground, the expense of many laborers might be saved. With these improvements and certain changes of administration, the author concludes that quicksilver can be produced at Almaden at a cost not exceeding one-third of that now incurred in the mines at New Almaden in California. B. S.

ART. IV.—*Extracts from the Address of* Sir RODERICK I. MURCHISON, *President of the Royal Geographical Society at the Anniversary meeting of the Society, May* 27, 1867.

AFRICA.—*Dr. Livingstone.*—During the last few months our thoughts have been directed with painful interest, to the last enterprise of our eminent associate, Livingstone. For reasons which I have explained at our evening meetings, and also through the public press, I have never admitted that there existed any valid proof whatever of the death of that great traveller. And now that Arab traders have arrived from a spot close to the reported scene of the murder, long after the event was said to have taken place, and brought to the Sultan of Zanzibar the intelligence that he had passed safely into the friendly Babisa country to the westward, and that a report has arrived at Zanzibar that a white man had reached the Lake Tanganyika, we have fresh grounds for hoping that he may now be pursuing his journey in the interior. In truth we have recently obtained good evidence of the mendacity of the man Moosa, on whose statement alone the death was reported—it being known that he has given one version of it to the Consul and Dr. Kirk at Zanzibar, and also to the British resident at Johana, and an entirely different one to the Sepoy examined, on his return to Bombay, by Colonel Rigby. We have, therefore, the strongest grounds for disbelieving the story altogether, and for hoping that our great traveller has passed safely through the intermediate country and reached the Lake Tanganyika, the great object of his mission.

Already Livingstone, by crossing the northern end of his own Lake Nyassa, has determined one important point in respect to the watershed of South Africa, for he has proved according to Dr. Kirk, that this great sheet of water here terminates, and is not connected with the more northerly Lake Tanganyika. If he has been spared, as we all hope, he has before him as grand a career as was ever laid out before an African explorer, it being now probable that Tanganyika, a fresh-water sea which must have an outlet, is connected on the north with the Albert Nyanza of Baker, and others belonging the Nile system. For although Burton and Speke estimated to the height of Lake Tanganyika to be little more than 1800 feet above the sea—the Albert, or lower lake being, according to Baker, 2720 feet—many persons, mistrusting the results obtained by the use of a bad thermometer, still think it probable that the Tanganyika may communicate through a gorge in the mountains at its northern end with the Albert Nyanza of Baker; for both these waters lie in the same meridian.

Pursuing this subject, our associate, Mr. Findlay, after a comparison of the altitude observations of Burton and Speke, on the first East African expedition, those of Speke and Grant on the second, and of Baker on his great journey to the Albert Nyanza, has prepared a memoir in which be endeavors to prove that these various altitudes are not inconsistent with Tanganyika being the furthermost lake of the Nile system, with an exit into Albert Nyanza. This important argumentative memoir will be read to us at our first meeting after the Anniversary.

For myself I give no opinion on a question which, like many others respecting African geography, can really be decided by positive survey only. Let us, then, trust that Livingstone has been enabled to solve this singularly interesting problem.

In the mean time not believing in the death of Livingstone on the sole testimony of one of his cowardly baggage-bearers who fled, and who has already given different versions of the catastrophe, I am sure the Society and the public will approve of the course I recommended, and in which I was cordially supported by the Council, and, to their great credit, by Her Majesty's Government, namely to send out a boat expedition to the head of Lake Nyassa, and thus ascertain the truth. If by this exhaustive search we ascertain that, sceptical as we are, the noble fellow did fall at that spot where the Johanna man said he was killed, why then, alas! at our next anniversary, it will be the sad duty of your President, in mourning for his loss, to dwell upon the wondrous achievements of his life. If, on the contrary, we should learn from our own envoys, and not merely from Arab traders, that he has passed on into the interior (and this we shall ascertain in six or seven months), why then, trusting to the skill and indomitable pluck of Livingstone, we may feel assured that, among friendly Negro tribes, who know that he is their steadfast friend, he may still realize one of the grandest geographical triumphs of our era, the connexion of the great Tanganyika with the waters of the Nile system.

But even here I would have my countrymen who are accustomed to obtain rapid intelligence of distant travellers not to despair if they should be a year or more without any news of our undaunted friend. For, if he be alive, they must recollect that he has with him a small band only of faithful negroes, no one of whom could be spared to traverse the wide regions between Lake Tanganyika and the coast. Until he himself reappears—and how long was he unheard of in his first great traverse of Southern Africa!—we have, therefore, little chance of knowing the true result of his mission. But if, as I fervently pray, he should return to us, with what open arms will

the country receive him! and how rejoiced will your President be, if he lives, to preside over as grand a Livingstone festival as he did when this noble and lion-hearted traveller was about to depart on his second great expedition.

The party which I have announced as about to proceed to Eastern Africa to procure accurate information concerning Livingstone, will be commanded by Mr. E. D. Young, who did excellent service in the former Zambesi expedition, in the management of the *Lady Nyassa* river-boat. With him will be associated Mr. Henry Faulkner, a young volunteer of great promise, and two acclimatised men, one a mechanic and the other a seaman. The expedition, I am happy to say, is warmly supported by Her Majesty's Government, and the building of the boat is rapidly progressing under the orders of the Board of Admiralty. The boat will be a sailing one, made of steel, and built in pieces, no one of which will weigh more than 50 lbs., so that the portage of the whole by natives past the cataracts of the Shiré will be much faciliated. The Government have arranged for the transport of the party to the Cape, with the boat and stores, by the African mail-steamer on the 9th of next month.* Arrived there, one of our cruisers will take them to the Luabo mouth of the Zambesi, where the boat will be put together, and the party—having engaged a crew of negroes—will be left to pursue their noble and adventurous errand, by the Zambesi and the Shiré, to the head of the Lake Nyassa. On account of the heavy seas which prevail on the western or leeward side of that lake, the expedition will keep close to its eastward shore, hitherto unexplored, and it is expected it will reach Kampunda, at the northern extremity, by the end of October, and there ascertain whether our great traveller has perished as reported, or has passed forward in safety through Cazembe to the Lake Tanganyika.

Senegal.—In former addresses I have had occasion to record the great services rendered to Geography by the enlightened Governor of the French possessions on the Senegal, Colonel Faidherbe, who has greatly extended our knowledge of the country along the banks of that river. The most advanced post of the French is Medine, near the cataracts of Felou, 600 miles from the mouth, up to which point the river is navigable during the rainy months, for vessels drawing 12 feet of water. With a view to ascertaining the political condition of the countries beyond the eastern frontier, as also to fix accurately the geographical positions of places between the Upper Sene-

* To the credit of the Union Steam Packet Company the boat has been taken out free of charge. Whilst these pages are passing through the press, I learn that the party sailed from Plymouth on the 11th instant.—*June* 12, 1867.

gal and the Niger, an expedition was sent out by Colonel Faidherbe, in 1863, to traverse the distance between Medine and the important town of Segou, which had been visited by our own renowned traveller Mungo Park, sixty years previously. The mission was most ably and successfully carried out by Lieutenant E. Madge and Dr. Quintin of the French navy. Countries recently desolated by semi-religious wars carried on by Mussulman chiefs were traversed with great danger, and the positions of the route carefully laid down; the road taken being a *détour* to the north, after crossing the Senegal, by Diangounté, to Yamina, on the Niger, and thence by canoe to Segou. By this journey Lieutenant Madge has filled up a void in all maps of the region of the Upper Senegal, and corrected the positions of many places as previously laid down by Mungo Park and others; but the accuracy of our English traveller in the most important points is cheerfully acknowledged by his accomplished French successor, especially, for instance, in the position of Yamina, which Mungo Park fixed at 13° 15′, and Lieutenant Madge found to be 13° 17′ N. lat. The expedition returned to the mouth of the Senegal in June, 1866, and the French Geographical Society in the present year has rewarded the courageous leader with one of its gold medals.

Asia.—Whilst, with the exception of the probable settlement of the north end of Lake Nyassa by the last journey of Livingstone, little has been added in the past year to our stock of knowledge respecting Africa, much information has in the same period been elicited regarding the geography of Central Asia, particularly as respects the physical features of those vast northern portions of it which have been explored by the Russians, and the positions of places and mountain ranges laid down by our own surveyors to the north of British India.

At the head of the labors which have elucidated the comparative geography of this quarter of the globe, I place the two remarkable volumes produced by our distinguished associate Colonel Henry Yule, C.B., entitled "Cathay and the Way Thither," published by our active auxiliaries, the members of the Hakluyt Society, and of whose productions our Secretary, Mr. Clements Markham is the perspicuous editor. Although the student of the former condition of China and the surrounding regions has ever dwelt with profit and delight on the descriptions of the great traveller Marco Polo, as first brought under the notice of modern English readers by Marsden, and as since rendered so popular by the excellent work of M. Pauthier, it was left for Colonel Yule vastly to extend our acquaintance with the amount of information possessed by our ances-

tors in the mediæval centuries which succeeded to the epoch when the great Venetian lived. By gathering together in one collection various records of other travellers in the East, commencing with those of the quaint and original Friar Odoric of Pordenone, in the fourteenth century, Colonel Yule has not only satisfied the cravings of scholars, but has at the same time gratified geographers by the preparation of a most instructive map of Asia, such as it was when explored by those earlier travellers, and when it was ruled over by the different branches of the family of Chinghiz Khan.

The contrast between the statistical and political condition of Asia, particularly its central portion, in those days when mercantile men traversed it freely from Azof or from Tabriz to India and China, and the present time, when there exists so small an amount of land intercourse with Europe, is truly astonishing. In those days, and even as late as the sixteenth century, Samarkand, a city renowned as a seat of Mohammedan learning, was frequented by embassies, including one from the King of Spain. Even our own Queen Elizabeth was so anxious in the first year of her reign to open out an intercourse by way of the Caspian with Persia and India, that she addressed a letter to "the Great Sophi, Emperor of the Medes and Parthians." It was then (1558) that Jenkinson, our English traveller, made the journey from Astrachan to Bokhara, passing by Urghendj.

Now, with the exception of Russia, whose mission in 1841 has been noticed in previous addresses, no European power has had any sort of intercourse with the truculent Emir of Bokhara, to whom much of this fine region is, alas! subjected. It has since been left to stray travellers, one of the last of whom is the enterprising Hungarian Vámbéry, to explain to the civilized world the real state of this region, once so important, and now so fallen through tyranny and misgovernment. No one can have read that author's sketch of the condition of the natives in either of the Khannats of Khiva or Bokhara, without rejoicing that Russia has, through the energy of her Government, at last brought these barbarians to respect the frontiers of an empire which has established a safe line of communication between its own territories and those of China.

One of the most important statistical results of modern geographical research, and the employment of natural means to a great end, is the bringing into real use, for the first time in history, the River Jaxartes of the ancients (now called the Syr Daria), and navigating it with steamers from its mouth on the Sea of Aral for many hundred miles into Turkistan and Kokand. By this great feat, and by the erection of forts, Russia

has established an entirely new and well-protected route between Europe and China, far to the north of that followed by travellers and merchants in the middle ages, which was from the south end of the Caspian.

England, holding as she does so high a maritime position among the nations, may reflect with satisfaction on her great eastern traffic with India and China carried on by her own great road, the ocean ; and, far from envying the recent opening out of this land and river route through Central Asia, she may be well pleased that her northern allies should have a beneficial commercial traffic by caravans with those fertile regions of northwestern China, with which, in fact, we never have had any intercourse, but with whom the Russians have traded for ages, though always until now with more or less impediment, due to the forays of the intermediate wild people, and particularly the Kokandians. The two great empires of Russia and China seem, in fact, to be destined by nature to interchange commodities by land and river communications through Central Asia ; and so long as the line of such commerce between them is separated, as it now is, from British India and its dependencies by mountainous, sterile and snowy regions, impassible by modern armies, there never can be the smallest ground of jealousy on the part of Britian.

On this head I was much gratified, at our very last meeting, in listening to the able memoir of Captain Sherard Osborn on the actual state of Chinese Tartary, an enormous region that has become, through the relaxation of the Chinese hold, "no man's land," and in hearing from the eloquent author, as well as from the commentators on his memoir, that, instead of any apprehension being entertained regarding the late Russian advances, it was generally felt that it would be greatly to the advantage of the natives, as well as to British power in India, that the influence of a civilized Christian nation should be extended eastward over a region now becoming desolate through misgovernment and lawlessness.*

These considerations lead me naturally to say a few words upon the geographical operations of our medallist Admiral Boutakoff, which have mainly led to the establishment of the new Russian line of eastern traffic, and which have justly obtained for him a high reputation. The first of these enterprises might almost be called the geographical discovery of the

* The reader who wishes to become acquainted with the physical features and boundaries of the districts of Chinese Tartary, so well expounded by Capt. Sherard Osborn, and of which he prepared a large map, must consult Keith Johnston's Library Map of Asia, published by Mr. Stanford, in the preparation of which, Mr. Trelawney Saunders took a leading part.

Aral Sea. For, although this great mass of salt water had been known to Arabian geographers during several centuries under the name of the Sea of Khwarezm, though its shores had been visited by travellers, one of whom was the accomplished Russian geographer George von Meyendorf, who described the mouths of the Syr Daria or Jaxartes, at its northeastern extremity, and another, General Berg,* who led a Russian expedition along its western banks in the winter of 1825–6, no ship had ever sailed upon this inland sea. The first vessel launched upon it was constructed at Orenburg in 1848, and transported in pieces across the desert, and in it Boutakoff, after two years of navigation, defined the real shape of the coast, established the depths of the sea, and was the discoverer of the large island in it, the wild antelopes of which came to stare with astonishment, yet without fear, at their first invaders.

Fifteen years have elapsed since I communicated the first important paper of Boutakoff to this Society, and it was spoken of with all the praise it merited in my Anniversary Address of the year 1853.† The successful exploration of the Jaxartes, and the discovery of its fitness for steam navigation, which was the next exploit of Boutakoff, led to the establishment of the great central route to China already mentioned, and Russia naturally availed herself of the commercial advantages thus presented in these natural features near the boundaries of her Asiatic possessions.

The question now arises, whether, by these enterprises, the honor does not truly belong to Russia, of having, for the first time in history, defined the course of the Syr Daria and its exit into the Sea of Aral? The classical writers were, as I shall presently show, ignorant of the true geography of this region, particularly of its northern part, and an attentive consideration of its geological structure and physical outlines has led me, followed by the inquiries I have made among comparative geographers who have well studied the subject, to believe that their silence with respect to the Aral Sea is no proof that it has not existed during the whole of the historical era.

Holding this opinion, I necessarily differ from my friend Sir H. Rawlinson, who, in observations recently delivered from the chair of this Society‡ made a very ingenious statement, and gave it as his opinion that there was sufficient evidence to show

* See the first published notice of the remarkable expedition of General Berg in 1825, in the work of myself and coadjutors, "Russia and the Ural Mountains," vol. i, p. 310. General Berg is now Count de Berg, and the emperor's representative in Russian Poland.

† Journal Royal Geographical Society, vol. xxiii, President's Address, p. lxxxvi.

‡ See "Proceedings," Royal Geographical Society, 11th March, 1867.

that in early times, say from 600 years before the Christian era to 500 or 600 years after it, both the river Oxus and Jaxartes flowed into the Caspian, the Aral being non-existent. That afterwards, and up to the year 1300, they fell into the Aral, and that for the next two hundred years (1300 to 1500) they came back into the Caspian, subsequently flowing gradually back into the Aral and forming the sea as we now know it.

Although I know that my colleague will admit that my geological data must have some weight, I have to claim his indulgence for venturing to question the views of so eminent a scholar respecting the changes of physical features in this region that may have happened in the days of history. Supported, however, as I am by the opinions of men on whose knowledge I place great reliance, I must say that I cannot regard the Persian manuscript, which was presented to Sir Henry by a clever chief of Herat, to be a document of sufficient value to override the conclusions at which I have arrived on many independent grounds.

Concerning the ancient course of the Oxus, I see no reason to differ from the Persian writer and Sir Henry. But when it is stated that in the year A. D. 1417 the Jaxartes had deviated from its former course and instead of flowing into the Caspian (as the ancients had it,) joined the Oxus, and thus, the two rivers occupying one and the same bed, came into that sea, I must withhold my assent. This is a novel and striking statement, and before we attach credence to it we must have some physical evidence to sustain it. In my state of scepticism regarding the value of this Persian manuscript, now for the first time produced, that which strikes me *à priori* as a sign of its invalidity, is, that when this region was open to knowledge through the long-enduring reign of the civilized and literary Arabians (say from the 7th to the 13th century), the Aral was known and laid down as a distinct water-basin under the name of Sea of Khwarezm. On the other hand, when after that period knowledge became dim and local, and civilization was at its lowest ebb, then it was that the Aral disappeared. My conclusion from this coincidence of the supposed emptying of the Aral, with the absence of records respecting it, would be that the sea had existed during all that time, but that there were then no geographers to record the fact.

In treating this subject, let us first consider the separation of the Aral from the Caspian as originally dependent on geological changes of the surface, and then proceed to estimate the value we are to attach to the writings of the classical authorities in reference to a region so very imperfectly known to them. As a geologist who has studied this Aralo-Caspian ques-

tion *in situ* I beg to place on record in our geographical volumes my view of the pre-historic physical outlines of a region which, with the exception of the obliteration of one mouth of the Oxus, has, I venture to think, undergone no essential change during the human period.

According to all good authorities, including Humboldt, there existed in the latest tertiary, or what some call quaternary times, a vast depression on the surface of the globe, extending over 8,000 square marine leagues, in which a great inland sea was accumulated, and which, in a work on Russia, my associates and myself first mapped out under Humboldt's name of Aralo-Caspian.* In that sea there lived an abundance of molluscous and other animals, all of species having a local and limited range, and all strikingly distinguished from the more numerous animals of oceanic seas. Now, owing to the upheaval of large portions of the bottom of that old inland sea, its animal contents formed, in a fossil state, the Steppe limestone, are seen at different levels over an enormous area. Owing to these pre-historic movements of the crust of the earth, these fossil remains are seen to occupy the strata on the banks of the lake of Aral, as well as on the shores of the Caspian Sea. They also occur at various places and at different heights in the adjacent Steppes, extending westward to the country of the Don Cossacks to the north of the Sea of Azof, where I have myself examined them. There is therefore no doubt that, in pre-historic times, the Aral and the Caspian, and also portions of a much wider region, now raised above them, were occupied by one vast internal and depressed sea, large portions of which have been desiccated. By these movements of elevation that part of the former great sea which became the Aral was elevated to about 117 ft. above the former western part, or present Caspian, and the seas thus insulated were separated through the same movements by the elevated plateau now called Ust-Urt.

This was the physical condition of the region long before tradition or history. Humboldt has well remarked that the great Aralo-Caspian depression had a similar origin to the much deeper cavity in the earth's surface occupied by the Dead Sea, though the one is only 83 feet and the other nearly 1300 feet beneath the Ocean. Now, if we endeavor to account theoretically for the low present level of the old Aralo-Caspian Sea by evaporation only, we are met by the facts that large portions of its former bottom have been raised to different al-

* See 'Russia in Europe and the Ural Mountains,' vol. i, pp. 303–314, and particularly observe the map and section, p. 311, from the Sea of Azof across the Caspian and the Ust-Urt to the Sea of Aral.

titudes in the surrounding region, and that the levels of the Sea of Aral and the Caspian are also different, and are separated by the great plateau of Ust-Urt. As it is impossible to explain the existence of the much deeper cavity of the Dead Sea except by a greater sinking of the earth's crust, so is such a phenomenon precisely what geologists would expect to see realized as a natural and compensating result of the corresponding upheaval of the adjacent lofty mountains of Asia.

This being the conclusion at which geologists have arrived, let us see if it be interfered with by any reliable historical records. As to the knowledge possessed by Alexander, or his contemporaries, it really does not touch the question of the relative courses of the Oxus and Jaxartes toward their mouths. For Alexander crossed the Oxus at about 400 miles above its mouth, and the most western point at which the great conqueror reached the Jaxartes was Cyropolis, where he passed it to defeat the Scythians; and that spot is about equidistant from the Aral Sea. Consequently, neither Alexander nor his generals could know anything of the real course of either river for great distances above their mouths. Scholars and comparative geographers doubt, indeed, if any weight can be attached to the unanimous statement of the Greeks, that both the Oxus and Jaxartes flowed into the Caspian, by mouths some 300 miles apart,* when they see how equally unanimous were the writers who came between Herodotus and Ptolemy in believing the Caspian to be but a gulf of the Northern Ocean! Again, we see how persistently the followers of Alexander confounded the Jaxartes itself with the Tanais, and fancied that they had doubled back upon the rear of Europe.

"The expedition of Alexander," says Humboldt, "far from extending or rectifying the geography of the Caspian Sea, confounded the Tanais with Jaxartes, and the Caucasus with the Paropamisus or Hindu Kush."† Again, "It is through a singular combination of circumstances that the great Macedonian expedition, which in other respects extended the geographical horizon of the Western nations, became fatal to the geography of the Caspian Sea."‡ Further on, he says, "Some traces of the Sea of Aral, described as a great basin to the east of the Ural or Jaike River, are indeed found in Menander, the Byzantine historiographer; but it is only with the series of Arabian geographers, at the head of whom, in the tenth century, we must place El-Istachry, that we first obtain a certain knowledge of the topography of the countries."§

* 2400 stadia according to Eratosthenes, and 80 parasangs according to Patroclus, both quoted by Strabo.

† 'Asie Centrale,' vol. ii, p. 14. ‡ Ibid., p. 153. § Ibid., p. 156.

The truth is, that, when it was thus loosely said, that both the Oxus and Jaxartes flowed into the Caspian, we must make due allowance for the ignorance of the ancients of the northern portion of this vast region, particularly of the course of the Jaxartes, which no one of them had fully explored, and at the mouth of which none of them had arrived.

If, indeed, we rely on the sagacious Rennell, he, in his great work on the 'Geographical System of Herodotus,' may be said to have established this point, for, in speaking of the old geographers, he says, "they understood the *Aral to be included in the Caspian*, since they knew of but one expanse of water in that quarter; for the Cyrus and Araxes, Oxus and Jaxartes, were all supposed to fall into the same sea." This he contrasts with the accurate subsequent knowledge of the Arabian geographers. And truly so, for this was the regular progress of observation, and a great advance over the ignorance of the classical writers respecting these hyperborean tracts. In those times the regions inhabited by the Massagatæ and the King of Khrasmia (the present Khiva) were barbarous countries, never explored by geographers; and, consequently, the classical authorities could only have obtained the little knowledge they possessed from native hearsay.

In his able essay on the 'Life of Alexander the Great,' Williams distinctly lays down, in his map of that period, the seas of the Aral and Caspian as distinct bodies of water. The same separation is given by Rennell, in his map of the twenty satrapies of Darius Hystaspes; and, whilst in it he indicates the Oxus flowing into the Caspian, and the Jaxartes into the Aral, he shows completely how the two seas were separated by what he terms the high plateau of Samob, the Ust-Urt of the present day.

Again, Thirlwall, in his 'History of Greece,' plainly leads us to believe that the Greeks could have known nothing of the region of the Sea of Aral and the mouth of the Jaxartes, except what they derived from the reports of the King of Kharasmia, who came from a distance in the north to visit Alexander. In short, there is no historical evidence whatever to to oppose the view, that the outline and structure of the Aralo-Caspian region, as now seen, was determined, as I have said, long anterior to the historical era.

On the point of the prehistoric separation of the Aral from the Caspian, I entirely concur with Humboldt. "If we ascend," he says, "to the primitive condition of the vast Mediterranean concavity, I should be led to believe that notwithstanding the diminution of surface which the Caspian and Aral basins may have undergone in the historical times, from

Hecatæus and Herodotus down to the tenth century of our era—*i. e.* to the days of the Arab geographers El-Istachry and Ebn Haukal—the event of the separation of the Aral and Caspian remounts to a geological epoch, which like the separation of the Euxine and the Caspian, or the opening out of the Dardanelles and Straits of Gibralter, are all ante-historical, or far beyond any human tradition."*

In sustaining this view it is to be remarked that, whilst the Aral Sea trends from north to south, the Syr Daria and its embrachment the Kuvan Daria, which flow into it from the east, have had courses at right angles to that sea itself; thus favoring the geological view that the great movement which produced the plateau of the Ust-Urt, separated the Sea of Aral from the Caspian, and left the chasm occupied by the Aral, was also accompanied (as is usual in such elevations) by transverse flanking openings in the mainland on the east, along which those rivers flowed. In this view the parallelism of the Syr Daria to that of the Kuvan Daria, about 50 miles south of it, is remarkable.

If the Jaxartes ever flowed to the southwest, as suggested by Sir H. Rawlinson, it must have joined the Oxus long before the united streams fell into the Caspian, which is very distant from the nearest point of the valley of the Oxus. But if such an union of the great streams ever existed in so southern a latitude, it must have been perfectly well known to the ancients, and they have made no allusion to it. On the contrary, they believed and have stated, that the rivers fell independently into the Caspian, and by different courses, separated from each other by a wide interval.

Whilst I think that, probably, the many-mouthed Oxus always sent a large portion of its waters into the Aral, I also quite believe that one of the branches debouched formerly into the Caspian, as explained by Humboldt, and as proved indeed by the old English traveller Jenkinson, to whom he refers. It will also be presently seen that the distinguished Asiatic geographer Semenof would explain the desiccation of the former or Caspian branch of the Oxus in another manner. The stoppage of that watercourse (formerly an usual line of traffic) may also be accounted for by a local elevation of land in that latitude; for it is not remote from the scene of igneous eruptions that produced volcanic mountains, as the greater and lesser Balkan, near the ancient desiccated mouth of the Oxus. Such a change of level may, indeed, have been caused by the same subterranean forces which, in this latitude, evolve, at the present day, the fires of Baku, and have recently thrown up

* Humboldt, 'Asie Centrale,' vol. ii, p. 146.

volcanic mud-islands near the southern end of the Caspian. The elevating effect of these forces would deflect the Caspian branch of the Oxus and cause its waters to unite with the branches which flowed northward into the Aral Sea.

The great distinction between the views taken by Sir Henry Rawlinson and myself is, that whilst I believe the main outlines of the Aralo-Caspian region were determined by movements of the earth in quaternary or later tertiary times, he refers the great changes which he believes to have been made in the courses of the Oxus and Jaxartes to no very distant historical dates; thus referring the emptying and refilling of the deep hollow in which the Aral Sea lies to comparatively modern times.

He offers, indeed, one argument, which, if sustained, would at once dispose of my view. In support of the opinion that the Aral sea was non-existent in the thirteenth and fourteenth centuries, he states that in those days travellers from Europe to Asia passed over dry lands since occupied by that sea. If this were substantiated, the belief I have adopted that the separation of the Aral from the Caspian, and the upheaval of the broad intervening plateau of the Ust-Urt, would be at once removed from a prehistoric period to the days of Henry III, and the two first Edwards of English history.

Now, surely, if so great a terrestrial change of surface as this had happened in the thirteenth or fourteenth centuries, the rumor of it would have been bruited throughout Europe and Asia. Unwilling, however, to rest upon any notions of my own, I have consulted that admirable comparative geographer, Colonel Yule, as to the routes taken by the mediæval travellers of that date; and he having favored me with much information respecting the whole of this subject, I extract from his letter the appended long note.* By reference to it the

* After alluding to the little weight to be attached to the statements of the Greeks, tracing the imperfect accounts of Herodotus and his followers, and rejecting the Oxiana Palus of Ptolemy, which had been made "to do duty," as he says, for the Aral on many respectable maps, Colonel Yule proceeds to say:—

"We are on surer ground in the narrative of the Embassy of Zemarchus to the Khan of the Turks about the year 570. The remains of the historian Menander, which relate this mission, are unfortunately but fragments, and do not say how Zemarchus got from Byzantium to Central Asia. But on his return route, which lay to the north of the Caspian we are told that before reaching the rivers *Ich* and *Daich* (apparently the modern Emba and Ural)[1] he passed for twelve days along the sandy margin of a certain *great and wide lagoon*. This looks very like the Aral; nor probably will Sir Henry Rawlinson deny its existence at that date. But I quote the allusion to show that even the Greeks, once they get actually to the site of the Aral, did recognize its existence.

"We now get to a period regarding which there is no controversy. A long

[1] "Perhaps, however, the *Ural* and *Ik*, so carrying the route north of Orenburg."

reader will see that no foundation for such an assertion is to be traced in the narratives of these old travellers. For even when the starting point of their journey eastward lay upon the Volga, their line of march is traced either quite to the south of the Aral through the lands of modern Khiva, or more to the north of that sea, and probably beyond sight even of its shores.

catena of geographical works, as Sir Henry Rawlinson tells us, represents the two great rivers as falling into the Sea of Khwarezm, *i. e.* the Aral. But is it the case that this chain of testimony ceases with the year 1300? Among those quoted by Humboldt even are some of later date, such as Abulfeda and the Persian Hamdallah. It is the case, no doubt that those Eastern geographers often copy what has been said by their predecessors centuries before; but a passage which Humboldt quotes from Hamdalla, a writer of the 14th century, appears to be original. It speaks of the Sea of Khwarezm (or Aral) as having a compass of 100 parasangs, and separated from the Caspian by a tract of 100 parasangs in width. It contains also the remarkable statement that only a *part* of the water of the Oxus then flowed into the said sea, which was fed also by the River of Ferghana (the Jaxartes) and others.

"Two centuries later, when the first English traveller[1] reaches those regions, he finds the Aral in existence, though his account of it is but hazy; and when Russian geography springs up at the end of the 16th century, we find that it already knows the Aral well as the Blue Sea.[2]

"Knowing then, as we do, how many indications point to the existence in those regions in recent geological times of a great inland sea, and finding a tolerable chain of evidence as to the Aral itself—either positive or implicit—down to the days of modern geography, I feel it difficult to believe, on the authority of the Persian MS., that this great sea, nearly 600 miles in circuit, with precipitous sides and attaining a depth of 37 fathoms, did, for a number of years, entirely cease to exist, and then again became as we see it and as old Arab geographers had described it. I by no means desire to dispute that there may have been a material contraction of its area at the time when a considerable part, if not the main stream, of the Oxus flowed into the Caspian; but this is a different thing from its entire disappearance and desiccation.

"There is one argument on this subject urged by Sir Henry Rawlinson which I think a review of the facts in detail will scarcely bear out. He refers to that period during the 13th and 14th centuries when the vast extent of the Mongol domination threw open Asia, which for a succession of years was penetrated by envoys, missionaries, and adveuturers, several of whose narratives have come down to us, and when a regular course of trade was established, regarding which we have many particulars.[3] The route usually followed by those travellers, Sir Henry says, lay exactly across the site of the Sea of Aral; yet not one of them mentions it. If this were so indeed, it would be vain to maintain the *improbability* of what would be so clearly established as a fact.

"But let us glance at the routes followed by these travellers successively from the first of them in the middle of the 13th century. This was Friar John of Plano Carpini, sent on a mission from the Pope to the great Khan in 1245–47. Friar John, though he writes in the main like a man of sense and reading, is not a good geographer. He makes the Dneiper, the Don, the Wolga, and the Jaic all fall into

[1] "Jenkinson."

[2] "See in Levchine's 'Description des hordes et des Steppes des Khirghiz Kazaks,' in his dissertation on the Jaxartes, p. 462, a quotation from a Russian geographical work of the time named."

[3] "Surely there is a *lapsus*, when Sir Henry Rawlinson speaks of these merchants as returning with the *tea* and silk of China; or, if he has grounds for including the former, it would be most interesting that they should be produced. In 'Cathay,' I have indicated the mention of tea by Ramusio's Persian friend Hajji Mahomed, as the first known to me in any European book.

In considering what changes have or may have occurred within the historic period, and quite independent of all former or geological changes, I necessarily attach great weight to the opinion I have recently obtained through my friend General Helmersen from M. P. Semenof, the President of the Physico-Geographical section of the Russian Geographical Society, who has distinguished himself by his researches in the Thian Shan

the *Great Sea*, the '*Mare Magnum*, which has its issue by St. Georg's Channel at Constantinople;' and rides for many days along the shores of the Caspian, apparently under the impression that it is but a part of the Euxine.[1] We might ask, in passing, if there were no Friar Johns among the ancients capable of the more venial error of confounding the Sea of Aral with the Caspian? Be this as it may, there is no reason for carrying the route of Carpini's party over the bed of the Aral. After crossing the Jaic, it lay for many days through the land of the *Cangitæ*, or Kankhlis, in which they found few people, but very many and large salt-marshes and lagoons, which they took to be the *Paludes Mœotides* of the ancients, and which probably were those which still exist to the north and northeast of the Aral.[2] They then enter the land of the *Bisermini*, or Mussulmans, and come upon the cities and cultivated lands of northern Turkestan.

"Friar William de Rubruquis, eight years later, is more correct in his notions of geography, He clearly discriminates the Caspian from the Euxine, and gives a fair account of it. He gives also the general orientation of his route, running due east from Wolga for 45 days and then turning southward, and so continuing for eight days till he reached *Kenchak*, a city known to have been in the valley of the river Talas. If you protract this route as well as the data will admit, you will find that it entirely clears the Aral.[3]

"Another traveller, who visited the court of Mongolia in the same year with Rubruquis, was King Hethum or Hayton, of little Armenia. He, too, after visiting Batu Khan upon the Wolga, rides eastward across the Jaic; but, as he passes the Irtish also, his route must have lain far to the north of the Aral. On his return he passed by Samarkand and Bokhara into Persia.

"Marco Polo himself never mentions the Aral, indeed; but neither does he mention the Jaxartes, and seems never to have been nearer either than at Kashgar. In the preliminary chapters of his book, in which he speaks of the journey made by his father and uncle from the Wolga to Bokhara, he unfortunately gives no particulars of their route,[4] excepting that they went south from Bolghar to Ukak (near Saratov) before striking east.[5]

"Probably, however, it was the same as that laid down in the next century from the information of the merchants who had travelled it, by the Florentine factor Balducci Pegolotti, about 1330–1340. This route, followed by mercantile travellers bound for China, ran from Sarai, on the Wolga, to Saracanco, or Saraichik, on the Jaic, and thence in camel-waggons to Urghanj, the capital of Khwarezm, which stood on a branch of the Oxus, about 60 miles south of the present embouchure of that river in the Aral Sea. From Urghanj the travellers were in the habit of proceeding to Otrar, a few miles north of the Jaxartes, and not far from the modern town of Turkestan, and so forward to the Almalik, near

[1] "See in D'Avezac's edition, p. 743."

[2] "See the narrative of Carpini's companion, Benedict the Pole, in D'Avezac, p. 777."

[3] "For a detailed examination of Friar William's route see 'Cathy and the Way Thither,' p. ccxi, *seqq.*"

[4] "The *Tigeri*, or Tigris River which Polo mentions as crossed by the party, was supposed by Marsden and his successors to be the Jaxartes; but Pauthier has clearly shown it to be the Wolga. (See his 'Polo' p. 8; also Cathay,' p. 234.)"

[5] Timur, invading Kipchak and Russia, went so far north as to cross the Tobol before crossing the Jaic.

chain of Central Asia. Whilst he rejects, like myself, the hypothesis of the great Aral depression having been emptied and refilled in the historical period, he refers the desiccation of the Asiatic rivers and the diminution of lakes to the decrease of glaciers in the high mountains, as well as to great evaporation. By these causes he thinks that at one period the Aral Sea may

the Ili, the capital of the Khanate of Chagatai. They thus travelled distinctly *round* and not across the bed of the Aral. We are told, indeed, that if they had no merchandise to dispose of at Urghanj, they might save from 5 to 10 days by going direct from Saraichik to Otrar. If we lay down this direct route with geometrical and literal directness, it will indeed pass through the extreme north of the Sea of Aral. But even direct railway lines are not so straight as that; and there can be little doubt that Pegolotti's direct line was much the same as that followed by Carpini and Rubruquis in the preceding century.

"The same route that Pegolotti recommends—viz., that from Sarai to Saraichik, and thence to Urghanj and Almalik—was followed by Friar Pascal, of Vittoria, in 1337,[1] (and as far as Urghanj) by Ibn Batuta, a few years earlier, in travelling from Sarai to Bokhara.

"It was probably also the route followed by John de'Marignolli, on his journey toward Peking, in 1339–42; but unfortunately, he says nothing whatever of his route between the two Mongol capitals of Sarai and Almalik.

"We have named all the travellers, as far as I am aware, that have left any record of their journeys in those regions during the period to which Sir Henry referred. None of them, we must acknowledge, say anything of the Aral Sea; but we see also that it cannot be maintained that they gave the practical disproof of its existence which would be afforded by their travelling dryshod across its bed! and the travellers' narratives were the bases of the maps to which Sir Henry has referred. The Catalan map does not, indeed, contain the Sea of Aral; but neither does it contain any hint of the Jaxartes. The great map of Fra Mauro, though it contains no Aral, represents the river Amu (or Oxus) as flowing into the Lake Issik-kul, which is, perhaps, an adumbration of some knowledge of its discharge into another sea than the Caspian. The traditions of geographers are hard to correct. I do not know what map first shows the Aral under anything like its proper conditions. Many years after the date of the Russian geography to which we have alluded as so clearly indicating the Aral under the name of the Blue Sea, we find John Blaeu, in his great Atlas (1663), representing the Jaxartes as flowing into the Caspian, and a duplicate of the same river, under the name of *Sur*, flowing by Tashkend into the 'Lake of Kathay,' with a difference of 30 degrees of longitude between the two! Even Petis de la Croix, in the maps (sometimes singularly happy) which illustrate his translation of the History of Timur, has no indication of the Aral.

"There is, indeed, one mediæval map which at first sight seems to bear strong testimony to the existence of the Aral Sea in the beginning of the 14th century. I mean that curious one executed by the old Venetion Marino Sanudo, and submitted by him to the Pope and King of France, about 1325, with his grand scheme for the destruction of the Mohammedan power. This map exhibits very clearly a *Mare Yrcanum Caspis* or *de Sara*, in the proper position of the Caspian. It is connected by a river with another sea, further east, marked *Mare Caspium*, and full of Islands, which is in a startling degree suggestive of the Aral. Further still to the east, toward *Sera*, appears a third and smaller sea, without a name, into which the *Gyon* flows (*i. e.* Jihun or Oxus). I dare not, however, lay much stress on this map, which contains almost nothing else to corroborate a claim to exacter information. The multiplied seas *may* have sprung only out of some misunderstanding of the classical geographers."[2]

[1] "'Cathay,' p. 232."

[2] "The map is engraved in 'Bongarsius, Gesta Dei per Francos,' vol. ii. There is a *quasi* facsimile of it in the second volume of Vincent; but in this latter the third sea is scarcely to be recognized."

have been diminished, though he is firmly of opinion that such a deep depression could not have been emptied and refilled. In reference, however, to the former Caspian branch of the Oxus, in the existence of which he believes, he supposes that many streams, now dry or nearly so, formerly augmented the volume of the Oxus, thus enabling it to supply a branch to the Caspian by the Gulf of Karabogas, and that to the failure of this supply we may attribute the drying up of the branch, without involving any great physical change of outline of the land. In this case the Aral Sea, occupying a separate cavity not communicating with the larger depression, would, as he thinks, become shallower, and to a great extent obscured by reeds, so as to have remained unknown to travellers for 500 years before and 500 years after Christ. M. Semenof suggests that in those days when the southwestern branch of the Oxus existed, travellers proceeding northward and meeting with little but reeds and marshes, might very well suppose that the Aral was merely an extension of the great Bay of Karabogas of the Caspian Sea. In illustration of this view he informs me that the inhabitants around the lakes Ala Kul and Sassyk-Kul have at this day no precise conception of their separation, and term them both Ala Kul simply, because they are unacquainted with the marshy and inaccessible isthmus between them. In Central Asia, too, the River Tchu, through its desiccation, has lost its former communication with the Lake Issyk-Kul, just as in the Aralo-Caspian region the Sary-su River has failed to reach Syr Daria; and this last river, having lost its northern affluents, could no longer contribute (if ever it did) by any of its branches to the Oxus, and has found an easier embouchure in the Aral. How easily these changes of direction are effected in the course of rivers in flat and sandy countries is well known to many Russian geographers who have explored Central Asia.

Thus, the Oxus, deprived of many of its former affluents, ceased to be able to throw any portion of its waters into the Caspian, and took the straight course into the Aral. This natural operation, as Semenof observes, may have also been accomplished within the historical period, and so, since its southwestern or Caspian branch dried up, the Oxus, by throwing all, instead of a part, of its waters into the Aral, has given to that sea a better marked place in human knowledge than it had in the fourteenth and fifteenth centuries.

Before I quit the subject of the now desiccated former branch of the Oxus I may state, on the authority of my correspondent, General Helmersen, that recently a memoir was presented to the Imperial Geographical Society of St. Peters-

burg, suggesting that men of science should be sent to the spot to examine into the evidences of that ancient bed of the river, and also to test, by soundings along the shore of the Caspian, if any remains of the old delta of that stream could be detected. But the project, as well as the continuation of the survey and soundings of the southern edges of the Caspian, have both been suspended, I believe from motives of economy. The latter important work was under the able direction of Captains Ivanchnizow and Oulsky, who had already proceeded so far that in less than three years they would have completed the survey of the whole of that vast interior sea; and it is indeed much to be regretted that a work of such great geographical interest should have thus been set aside.

In conclusion, my belief is :—1. That the Caspian and Aral have existed as separate seas before and during all the historic period. 2. That the main course of the rivers Jaxartes and Oxus, as also of the sites of the Caspian and Aral seas, were determined in a prehistoric period. 3. That at one time the Oxus emptied itself both into the Caspian and the Aral, and that the Caspian branch-stream was sent back to the course of the other portion of the stream, either by the local rise of some lands between Khiva and the Caspian, or by desiccation and a want of sufficient power of water. And, lastly, that the Jaxartes never was deflected from its natural east to west course, to pass southward, and so reach the Caspian by the southern end of the great elevation of the Ust-Urt, after a very long course at right angles to its present direction, to say nothing of its having in that case necessarily united with the Oxus by the way—a fact, of which, as already stated, all history is silent.

If old authors believed, without personal observation, that the Jaxartes, as well as the Oxus fell independently into what they called the Caspian, we may easily account for such a notion, at a time when the true meridian of barbarous places lying to the north of any line of intercourse between Greece or Rome and Asia was wholly undetermined. May we not rationally infer that the ancient geographers believed that the Jaxartes, as well as the Oxus, flowed into the Caspian, simply, as suggested by Rennell, from having heard that the Jaxartes terminated in one great sea, and that they naturally believed that the Aral was then simply the northeastern portion of those large inland waters of which they had heard, but of which they knew nothing accurately.

In truth, when we know that the geography of the Greeks, and even of the Romans, was worthless, in regard to any lands beyond the parallel of the mouth of the Oxus, we necessarily recur to the works of the earliest Arabian geographers, in which

the Sea of Khwarezm was first exhibited as a separate sea. As such it also appears in the maps of Rennell, of Williams, of Yule, and, in short, of all the best authorities, representing that which I believe to have been the true physical condition of the region during all historical time, and which I maintain dated from an ante-historical period.

In estimating the present or future relative importance of the Oxus and Jaxartes as lines of commercial traffic with China and India, I have no hesitation in saying that the latter river holds the first place. By reference to the memoir of Lieut. Wood, in the tenth volume of our "Journal," describing the sources of the Oxus, and still better by inspecting the map of the Bolor Mountains and Upper Sources of the Oxus, which has just appeared in our present volume (vol. 36), I agree with the able Russian geographer Veniukof, who, after alluding to the wild barbarian races which occupy the high tableland of Pamir and the adjacent mountains, adds this significant passage: "When we, moreover, remember that this basin of the sources of the Oxus is closed in on the north, east, and south by mountains from 15,000 to 18,000 feet high, and across which the roads for pack-animals are few and difficult to traverse, we must arrive at the conclusion, that all idea of converting this region into a rich entrepot for a trade with India and China must be abandoned."*

Before I quit the subject of the investigation of Central Asia, let me ask those of my countrymen who read German with facility, to peruse the great work of Ritter, the "Erdkunde von Asien;" and they will at once learn how to value the vast amount of modern discovery which is due to our Russian co-temporaries.

On former occasions I have naturally adverted to several of these remarkable researches; but I regret that, in my last two Addresses, I have omitted to notice, as I now do with special approbation, the memoir of M. Semenof, published in our Thirty-fifth Volume, on "Djungaria and the Celestial Mountains." As the only man of modern times who has explored a considerable portion of the Thian-Shan or Celestial Range, M. Semenof must be placed among the most distinguished of the famous band of Russian explorers—not simply for having determined many geographical positions, the forms of land and their altitudes, but also for his careful examination of the mineral character of the rocks which constitute the loftiest masses of those regions. In so doing, he has set aside one of the few errors which the illustrious Humboldt fell into in his

* "Journal of the Royal Geographical Society," vol. xxxvi, p. 263.

grand generalizations, when he was led to believe that the Thian-Shan—the great axial range of Central Asia—must be essentially one of volcanic eruption.

Influenced, doubtless, by his successful description of the Andes of South America, and the rise to their summits of active volcanoes, the great traveller was very naturally disposed to apply the same inference to the lofty chains of Central Asia; the more so as all the imperfect data he could collect seemed to indicate the existence of rocks of that class.

But as soon as the Thian-Shan was examined by the only man of science in our age who has visited it, he found nothing but sedimentary strata; and as this important rectification is due to M. Semenof alone, we must not only accord to him all due praise as a geographer, but it is specially my duty as a geologist to thank him for making this great observation.

In fact, the grand movements of upheaval, which determined the form of many of the loftiest mountains, whether in Central Asia or in the great northern barrier of India, the Himalayas, were caused by former expansions from the interior, doubtless due to the central heat, which raised up sea-bottoms, often altering them into crystallized rocks, and elevating them to enormous altitudes, without exhibiting any true igneous rocks.

Having already twice alluded to the recent discoveries in Asia by the Russians, and we having endeavored to do honor to them by the award of our Founder's Medal to one of the most distinguished Russian explorers, it is now my pleasing duty to advert to others of their recent labors in that quarter of the globe.

On former occasions I have dwelt upon the explorations of Eastern Siberia and the affluents of the grand River Amur and the mountains to the north. Let us now turn to Central Asia proper, and see what good documents have been furnished by the different men of science who have explored those regions. I gather from the bulletins of the Imperial Geographical Society that the communications of MM. Semenof, Severtzof, Poltarazky, Abramof, Bakkof, Goloubef, and Printz, explain the physical conformation of tracts and the natural riches of regions never before reached in modern times.

Of most of these hitherto unknown wild tracts the Russian explorers have prepared or are preparing maps. To faciliate journeys from Siberia to Pekin, Dr. Brettschneider, the physician to the Russian mission in China, has laid down upon a map all the different known roads across Mongolia, of which that which is called the post road is 1760 versts long, between Kiachta and Pekin, with 68 relays. If the telegraph, which

one of our countrymen, Mr. Gordon, who had travelled across this desert, sought to realize, be established, the journey across the desert of Gobi will soon be thought nothing of.

As to Bokhara, of which Englishmen have only painful recollections, on account of the murder of our distinguished officers, Conolly and Stoddart, we now know that two Russians, MM. Gloukovsky and Tatarinof, who were for seven months captives there, have added much knowledge to that acquired by their accomplished countrymen Khanikoff and Lehmann in 1842.

Those of our associates who may now visit St. Petersburg may see pictorial views of Khodjend, Tashkend, and all the places taken from the Kokandians in the recent advance of the Russians along the Syr Daria and now forming parts of the great new province of Turkestan. I learn also, in reference to this region, so recently opened out to the civilized world, that M. Struve, the son of the great Russian astronomer, has prepared a map of the whole province of Turkestan, on a scale of 40 versts to the inch.

Deeply interested as we must all be in this grand opening out to geographers of a vast unknown country, my first request to my eminent friend Admiral Count Lütke must be, that as President of the Imperial Geographical Society and also of the Imperial Academy, he will procure for our Society copies of the maps which, to their great credit, the Russian geographers have prepared.

ART. V.—*Contributions from the Sheffield Laboratory of Yale College.* No. XVI. *Contributions to Mineralogy;* by BEVERLY S. BURTON, Ph.B., Assistant in the Sheffield Laboratory.

I. *Enargite from Colorado.*

AMONG a series of ores received by Prof. Brush from Dr. Chas. Johnson of Colorado was a lustrous grayish black mineral, labelled "Sulph-antimonid of copper with arsenic," from Willis' Gulch, Colorado. It was found in a vein associated with iron pyrites and quartz. It has a perfect cleavage giving a brilliant metallic luster. Sp. gr.=4·43. H.=3. In the closed tube the mineral decrepitates and at a higher heat fuses, giving a sublimate of sulphur and sulphid of arsenic. In the open tube yields sulphurous acid and fumes of antimony with a crystalline sublimate of arsenous acid. B.B. on charcoal affords a strong odor of arsenic and a faint white coating of antimony. The roasted mineral treated with soda gives a globule of me-

tallic copper. A qualitative analysis of the mineral showed the presence of sulphur, copper, antimony, arsenic and iron.

In the quantitative analysis the mineral was decomposed by the chlorine method; about one gram of it was placed in the bulb of an ordinary reduction tube and treated in the usual manner with a slow stream of chlorine gas, the volatilized product being made to pass through a mixture of chlorhydric and tartaric acids. The apparatus employed was the same as recommended by Rose with the exception that the U tube was replaced by a tube filled with glass fragments saturated with the acid mixture. The action of the chlorine was continued for nearly an hour, when the bulb was detached and the chlorids of copper and iron were dissolved in dilute chlorhydric acid, leaving a small insoluble residue of undecomposed mineral. The copper was thrown down from the hot solution by sulphydric acid, under which circumstances it is easily washed without fear of oxydation; it was then dried and weighed as disulphid (Cu_2S). The iron was determined in the filtrate as sesquioxyd and reserved for the addition of the volatile portion. From the acid solution containing the volatilized chlorids the sulphur was thrown down as sulphate of baryta, and after removal of the excess of baryta salt, the arsenic was separated by the ammonia-magnesia solution. The antimony was precipitated from the filtrate by sulphydric acid, the precipitate dried at 100° C., and the antimony determined by heating a portion of it in a dry current of carbonic acid, and from this the total amount was calculated. The small portion of iron in the filtrate from the antimony was thrown down as sulphid, redissolved and converted into sesquioxyd and added to the portion previously obtained. Two analyses conducted in this manner gave:

	I.	II.	Mean.
Sulphur,	31·46	31·67	31·56
Copper,	47·34	47·82	47·58
Arsenic,	17·67	17·93	17·80
Antimony,	1·25	1·50	1·37
Iron,	1·17	·91	1·04
	98·89	99·83	99·35

In No. 1, the insoluble residue was 2·16 pr. ct., in No. 2, 1·79 pr. ct., which amounts have been deducted from the above results. The ratio of the equivalents of arsenic, copper and sulphur is 1 : 6 : 8, giving the formula $3Cu_2S+AsS_5$. This is the composition of Breithaupt's *Enargite* as determined from Plattner's* analysis of the mineral from Peru, and also of the so-called Guayacanite from Chili, analyzed and described by Field.†

* Pogg. Ann., lxxx, 283.

† This Journal, II, xxvii, 252.

It is also in close accordance with Dr. Genth's* analysis of the enargite from Brewer's mine in South Carolina. The results demonstrate the mineral to be enargite, and this conclusion is fully sustained by its physical characters.

II. *Argentiferous Jamesonite.*

In the metallurgical collection of the Sheffield Scientific School is an interesting suite of ores from the Sheba Mine, Star City, Nevada, and among these Prof. Brush found an argentiferous sulph-antimonid of lead which he handed me for quantitative examination. The mineral is of a bluish white color, is massive to coarsely fibrous or columnar, and is associated with quartz, zinc-blende and tetrahedrite. H.=2·5. Sp. Gr.=6·03.

In the closed tube gives a sublimate of sulphur and sulphid of antimony. In the open tube affords sulphurous and antimonial fumes. B.B. on charcoal gives copious fumes of sulphur and antimony, with a coating of oxyds of antimony and lead, and yields a globule of lead, which on cupellation affords silver. A qualitative examination gave evidences of sulphur, antimony, lead, silver, copper and iron.

In the quantitative analysis the mineral was decomposed by chlorine as described under enargite. The contents of the bulb tube were removed and treated with dilute chlorhydric acid, brought upon a filter, washed with hot water, and the chlorid of lead thus dissolved was precipitated as sulphate. From the filtrate the copper was thrown down as sulphid by sulphydric acid gas. The residue containing the undecomposed mineral with chlorid of silver was washed upon the filter with ammonia to dissolve the latter, and the silver was subsequently separated as chlorid by acidulating the solution with nitric acid. As the first determination of sulphur proved low, an additional absorbent was attached to the end of the tube filled with glass fragments in the form of a nitrogen bulb apparatus, containing the mixture of chlorhydric and tartaric acids and a separate determination made; by this means the amount of sulphur was increased more than half a per cent. The antimony was determined as in the enargite. The results of two analyses were as follows:—

	I.	II.	Mean.			
Sulphur,	....	19·06	19·06	1·19		5
Antimony,	29·08	29·45	29·26	·24		1
Lead,	44·25	43·68	43·86	·424	·50	2
Silver,	6·15	6·13	6·14	·056		
Copper,	1·72	1·39	1·55	·024		
Iron,	·05	·05	·05			
		99·76	100·02			

* This Journal, II, xxiii, p. 420.

No. 1, gave 1·34 pr. ct. insoluble residue, and No. 2, 1·72 pr. ct. which have been deducted from the above. The ratio of the combined equivalents of the lead, silver and copper to the antimony and sulphur is as 0·50 : 0·24 : 1·19 or very nearly 2 : 1 : 5, giving the formula $2(Pb, Ag, Cu)S+SbS_3$. This corresponds to the formula of Jamesonite, of which it seems to form an argentiferous variety. The content of silver may indicate its possible relation to Brogniardite, an antimonial sulphuret of lead and silver of like atomic proportions but containing a much larger amount of silver than the Nevada mineral. For the analyses the mineral was selected with great care, and it appeared perfectly homogeneous.

III. *Argentiferous Tetrahedrite.*

This mineral was one of a number presented to the metallurgical museum from the De Soto Mine, Star City, Nevada. It occurs in compact masses of a light gray color and is associated with quartz, zinc blende and pyrites. It is readily selected entirely free from impurities. Specific gravity 5·00. On examination it gave the pyrognostic characters of tetrahedrite, and the globule of copper obtained by reduction of the roasted assay gave on cupellation a comparatively large globule of silver.

For the analysis the same method of decomposition was employed as with the preceding minerals, with this modification: instead of using a bulb reduction tube, a straight tube was substituted in which the mineral was placed in a porcelain boat, and a nitrogen bulb tube was also added to the absorption apparatus as in the examination of Jamesonite. After the chlorine had been allowed to act a sufficient length of time, the boat was withdrawn and treated with dilute chlorhydric acid, and the chlorid of copper, thus separated from the insoluble chlorid of silver, was then precipitated with sulphydric acid and weighed as disulphid. The chlorid of silver was separated from the insoluble residue by solution in ammonia. It was found by use of the boat that a more perfect decomposition was effected than with the bulb reduction tube, and as it is much more convenient for the removal of the non-volatile chlorids, its use can be highly recommended to all who have occasion to employ this method of decomposing sulphids. In removing the chlorid of sulphur which condenses in the bend of the tube connected with the absorption apparatus, I have found that this does not readily absorb moisture from the air, even standing as directed for twenty-four hours, but this may be easily effected without generating heat by drawing a slow current of moist air through the apparatus by means of an aspi-

rator. The sulphur and the antimony were determined as in the previous analyses. The iron and zinc in the filtrate from the antimony were thrown down by sulphid of ammonium, redissolved in chlorhydric acid, the iron precipitated by ammonia in excess, and the zinc subsequently separated by carbonate of soda. Two analyses gave :—

	I.	II.
Sulphur,.....	24·35	24.54
Antimony,.....	27·35	27·86
Copper, ...	27·40	27·42
Silver, ...	14·59	14·49
Zinc,.....	2·31	....
Iron,.....	4·27	....
Insoluble, ...	0·35	0·56
	100·62	

This corresponds closely with the argentiferous tetrahedrites analyzed by Rose and Klaproth from Wolfach.

These analyses were undertaken at the suggestion of Prof. Brush, and I would here express my thanks to him for his kind assistance in the above examinations.

ART. VI. — *On the occurrence of thick beds of Bituminous Gneiss and Mica Schist in the Nullaberg, parish of Ostmark, Province of Wermland, in Sweden;* by L. I. IGELSTRÖM.*

THE parish of Ostmark, as well as other parts of western and northern Wermland, is filled with high and steep hills of hyperite, between which the common crystalline rocks, gneiss, hornblende, mica schist and others, intervene. The bituminous gneiss and mica schist occur interstratified in common reddish granite-gneiss at the western part of the high and precipitous Nullaberg, occupying a thickness of more than 120 feet, and extending along almost the whole side of the mountain. The dip of the strata is about 70° eastward, and they are covered first by a bed of hyperite, and then with parallel strata of other granitoid rocks.

Generally, the bituminous substance is rather uniformly distributed, through the range, in the gneiss as well as in the mica schist, and the entire mass has a black color. The naked eye is hardly able to discern any particles of coal. When coarsely ground the rock resembles gunpowder, but when ground finer, it grows darker, either of the color of soot, or resembling pyro-

* Translation received from the author. Published in Swedish in the Œfv. Ak. Stockholm, 1867.

lusite. When beaten with the hammer, it emits a bituminous smell, like anthraconite, and also when heated by the blowpipe; it then gives a flame. On calcining 5·32 grams in an open crucible of platinum, I was not able completely to burn the whole of the bituminous substance, even after adding nitric acid several times; a little coal always remaining unconsumed. The loss of weight, however, was 12·03 per cent; the ashes were gray. When heated in a retort of thin iron, twelve pounds emitted much combustible gas, while a yellow combustible oil, as well as a colorless incombustible fluid, was collected in the receiver. When the gas was allowed to escape through a hole of one inch in diameter a fine and bright flame was obtained during four hours: during the fifth and sixth hour the flame grew more blue and fainter. The powder in the retort remained as black as before the distillation, though with a rather higher luster. It had lost 15·6 per cent of its volume. The specific gravity of the rock is 2·19.* It is so loose, that a man may in about half an hour sink in it a hole of two feet.

On a closer examination of the bituminous strata it is very difficult, from the general homogeneousness of the bed to decide whether and where it is gneiss, or mica schist, that is, impregnated with bitumen, but nevertheless one finds that both the above-named rocks, and also thin layers of chlorite schist constitute parts of the range. Thus, above the main bed and somewhat separated from it, I met with thin layers of common mica schist, alternating with layers of mica schist more or less impregnated with bitumen. Silvery laminæ of mica also form thin seams in the main bed. With regard to the gneiss, on the other hand, one occasionally meets in the black bituminous rock with somewhat paler stripes and seams, showing that feldspar here forms the principal constituent of the mass. The stratification is, however, distinct enough to make evident that it is not a dyke, but stratified gneiss and mica schist, conformable to the surrounding parts, which is here in view. In some places the bituminous rock contains round, whitish, thinly interspersed particles of the size of a pea, as well as nodules of anthracite of about the same size. As I first supposed the latter to be asphalt, I concluded, that the whole bed was impregnated with that substance; when, however, these nodules afterwards were proved, by experiments, to be anthracite, that supposition lost its foundation and yet I cannot decide what kind of bituminous substance it is, that to so large an extent impregnates the rock. It seems nevertheless to be very obvious, that the impregnation is analogous to that in alum-slate, for instance, and that conse-

* When weighed in the hand, it feels very light compared with silicates in general.

quently our gneiss and mica schist must be removed from the place they occupy as "primitive rocks," to the series of sedimentary and fossiliferous strata, as limestone, alum-slate, &c.

[A section here omitted represents the hyperite, and reddish granitoid gneiss forming parallel beds with thin slaty layers of bituminous mica schist, and fine grained gneiss.]

Chemical analysis of the rock, by F. L. EKMAN.

The following are the results of an analysis of various specimens of Nullaberg rock from the mineralogical collection of the Royal Academy of Science in Stockholm. * * * *

In five specimens of different character I found the following proportions of organic matter, (traces of water included) and carbonate of lime:

	1.	2.	3.	4.	5.
Organic matter,	7·10	10·67	10·36	5·44	9·08
Carbonate of lime,	2·57	(0·07)	14·30	2.75	0·00

The following is the analysis of the rock, when free from organic matter and carbonate of lime:

Si 65·03, Al 19·61, Fe 0·45, Ca 0·19, Mg 0·20, K 14·46, Na 1·06 = 100·00

When larger quantities (40 to 80 grams) were digested at the ordinary temperature with dilute nitric acid, well determinable quantities were obtained of phosphoric acid and chlorine, as also of lime, the last even in the specimen 5 (in which, though 11 grams were analyzed, no carbonic acid was found.) Hence one may conclude that the rock contains a little apatite. Traces of manganese and copper were also observed. The siliceous ingredients of the rock were also somewhat attacked, and as may perhaps be inferred, the traces of silica were separated before testing for phosphoric acid.

The organic ingredient may be easily obtained in a very pure state by washing, when a sufficient quantity of the rock is employed. The purest specimen that I obtained afforded after combustion only 3·17 p. c. of a reddish ash, but still contained some mineral fragments. The ash, of which such fragments constituted perhaps the principal part, showed no reaction on Curcuma-paper. In a few centigrams, collected after analysis, I found gypsum, oxyd of iron, silica (and phosphoric acid ?) apparently derived from the combustion of the organic matter.

The carbonaceous substance thus purified forms a light powder of a beautiful bluish black color. It is but slightly hygroscopic and is not easily wetted with water. When heated, agglutinates a little, but without melting or sensibly changing its state of aggregation, and produces a transient but brilliant flame; the remaining coal smolders away very slowly. The

specific gravity I found to be 1·299; after the removal of all remaining stony matter, it would probably be about 1·27. Analysis by combustion gave the following results: (ash and water being removed.)

The carbonaceous substance obtained from

	No. 3.	No. 2.		Medium.
Carbon, ...	88·68	88·79	—	88·74
Hydrogen,.....	5·35	5·56	—	5·46
Nitrogen,.....	—	—	0·67	0·67
Oxygen,.....	—	—	—	5·13
				100·00

The carbonaceous substance is generally but little affected by solvents. Spirit of 90 per cent pure alcohol became yellow and dissolved scarcely one per cent* of a substance, probably colorless when pure and easily soluble in alcohol; when heated it yielded a thick white vapor and slowly blackened. Ether dissolved ½ per cent of a substance of the same nature but less colored. Chloroform, like alcohol, was colored deep yellow and left a similar residuum, the quantity of which was however not determined. Oil of turpentine had no more dissolving effect than alcohol or ether. The experiments with alcohol, ether and oil of turpentine, were performed by boiling the substance in the solvents for several hours.

A warm solution of 1 part of caustic potash in 6 parts of water dissolved 5 per cent and became black-brown. From this solution by the action of acids was obtained a very voluminous brown precipitate soluble in pure water. After the extraction of this 5 per cent, the remainder was unalterable in a heated solution of caustic potash, though exposed for several hours to its action.

The following are the results of some experiments made with reference to the products of dry distillation, performed on a small scale, the presence of air being as much as possible avoided, and in an apparatus that permitted a bright red-heat. When rapidly heated the substance* gave carbon 74 p. c. and volatile products 26 p. c. When slowly heated it gave 11 p. c. fluid products, of which about ¾ consisted of a yellow neutral oil, lighter the than water; the gases developed were first acid, afterwards alkaline, and the water after distillation was strongly alkaline.

1 gram of the substance gave, rapidly heated, 258 c. c. of gas of 23° C., collected and measured over water. In the gas, when fully purified from carbonic acid, I found 2·7 vol. p. c. of hydrocarbons absorbable by bromine. In another experiment,

* The substance always considered as free from ash.

where the oils were for the most part decomposed during the distillation, 313 c. c. of gas were obtained from 1 gram of the substance.

In the analysis of the organic substance, no attention was paid to the amount of sulphur contained. Even in the original rock, when melted with carbonate of soda, this element plainly shows itself, and in the carbonaceous substance, containing 3·17 p. c. ash, I found no less than 0·81 p. c. Whether the iron observed in the ash be there in sufficient quantity to unite with the sulphur and make pyrite, or whether, as is possible, there be an overplus of sulphur contained in the organic substance, is as yet undecided.

Art. VII.—*On a new Binocular Eye-piece for high powers;* by H. L. Smith, Kenyon College.

While experimenting with the apparatus for illumination of opake objects under high powers of the microscope, a description of which was subsequently published in this Journal,* the idea occurred to me that by using a small rectangular prism for the reflector of the illuminator, and a side tube that could be attached to it at pleasure, a binocular arrangement similar to that now made by Mr. Nachet could readily be adapted to any monocular instrument. I sent drawings to Mr. Wales for this purpose, some time before the publication already alluded to, requesting him also, to try for the reflector a plate of parallel glass, in such manner that the light reflected from one surface might pass up the side tube, and the light transmitted through the glass, up the main tube. Upon further thought, I devised the eye-piece now to be described, in order to more equally divide the light in the two tubes; and, feeling satisfied after roughly trying it, that it would be much superior to the plan I had suggested to Mr. Wales, I desired him to defer for a time the construction of the apparatus for which I had sent him the plans.

Having brought the illuminator to public notice, I tried again the effect of an eye-piece constructed mainly as described herein, with temporary tubes, and holding the apparatus in place simply while using it; although I did not notice any injurious reflection from the back surface of the glass plate, still, fearing this, I proposed to make it sufficiently wedge-shaped to throw the image from the posterior surface entirely out of the field, and to correct for the transmitted rays by making the

* Vol. xl, No. 119, Sept. 1865.

wedge achromatic. I sent to Messrs. Powell & Leland a description of the eye-piece, requesting them to make it. Before receiving a reply from them, further experiment showed me that the most trifling amount of angle in a wedge of plain glass was sufficient to throw both reflected images together; when the refracting edge was placed upward, at the same time, the chromatic dispersion of the transmitted rays was imperceptible. Messrs. Powell & Leland replied: "You will no doubt be surprised to hear that we have patented a principle of binocular vision similar to what you propose. We exhibited it at the meeting of the Royal Society in March last." They also state that they got rid of the double reflection by other means than I had suggested, and seem doubtful whether my plan would work.

It apppears that the plan they had adopted was that which I had, more than six months previously, suggested to Mr. Wales, and which I had laid aside for the more perfect form. Evidently, the use of the Illuminator, as they constructed it, with a reflector of plate glass, first suggested the idea to them. Indeed, such an application could hardly have escaped the notice of those clever opticians. Shortly after, came a description of Mr. Wenham's improvement on Powell & Leland's arrangement, and which was said to afford a light nearly equal in each tube.

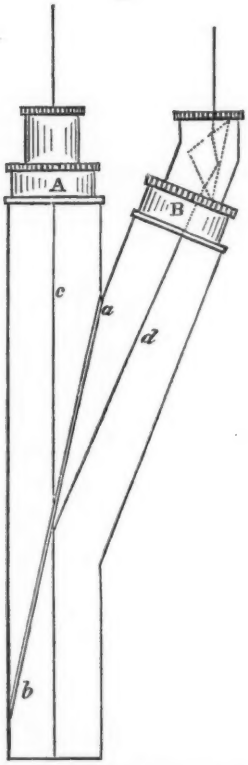
As this accomplished all I had been experimenting for, I gave the subject no further attention until after my return from England a few months since. I learned while there, that Mr. Wenham's contrivance was considered impracticable; it required a nicety of arrangement of the prisms which entirely unfitted it for ordinary use, however well it might operate in the hands of this most ingenious microscopist. I had several opportunities, both at Mr. Powell's house, and by the courtesy of Mr. Lobb, of witnessing the best performance of Powell & Leland's contrivance. It had certainly, a stereoscopic effect, and was, especially as manipulated by Mr. Lobb, much better than I had supposed it could be, still, the image in the extra tube was very faint.

Mr. Wenham, it is fair to say, alludes to the employment of a very thin wedge as a substitute for Powell & Leland's thick glass, in his paper published in the Microscopical Journal, July, 1866, and also, when alluding to the very small per cent of rays reflected in Messrs. Powell & Leland's arrangement, viz., 53·66 out of 1000, remarks: "To collect half the light the reflector would have to be set at 82½°, but this would cause the glass plate to extend to such a length, as to render the adaptation nearly impracticable." If Mr. Wenham had tried

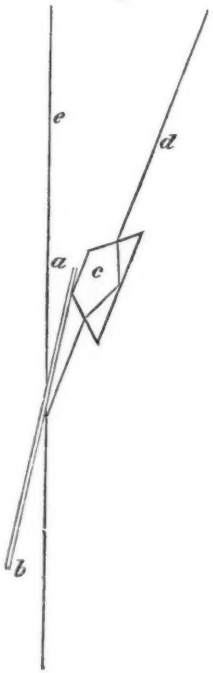
this he would have found that a glass plate two and a half inches long, would have answered every purpose and the construction in his hands would have been very easy. It will be at once perceived in the following description, that the images in the two fields are identical; or at least, so nearly so, that it is difficult to perceive any difference, and yet, most unexpectedly, there is a very considerable, and a very agreeable stereoscopic effect. Whatever theory may say, the fact is unquestionable. There is always a certain effect of depth or stereoscopic relief in using the monocular instrument, arising doubtless from the fact, that the parts not immediately in focus are somewhat blurred or doubled, and also from a sort of parallax, which causes a movement of the different parts of the image, readily seen as one looks alternately through the field by moving the head from side to side; the pulsation of the arteries causes movement. I have found sometimes this movement a great hindrance to steady vision of exceedingly delicate objects seen under very high powers. The fact of using both eyes, with two fields illuminated exactly alike, gives great physical relief, which imagination, if one chooses to call it so, gives very decidedly, a pleasing stereoscopic effect. The ingenious experiments of Mr. Claudet with the Thaumatrope, as described in the "Proceedings of the Royal Society," No. 92, (1867) show that the eyes are capable of appreciating a difference in the distance of two objects, which are only the $\frac{1}{1260}$ of the whole distance apart. Possibly, in the case of this binocular arrangement there may be a real, though infinitesimal difference in the two images. Certainly the rays do not all strike the glass at the same angle as they converge from the objective. It is not to be supposed, that, with very low power, the stereoscopic effect is as complete as that obtained by employing one-half of the objective for each tube, and perhaps therefore, this form may never wholly supercede the use of the "Wenham prism," yet it is so far satisfactory, even into the lowest powers, that one could hardly desire anything better, while with the higher powers, from the $\frac{1}{3}$th up to $\frac{1}{8}\frac{1}{0}$th, it is infinitely superior. The eye-pieces I have made, and now have in use, have for the reflecting plate or wedge, simply slips of glass cut from photographic plate, and the ordinary thin glass used for cheap looking-glasses. It is quite easy, by holding the plate between the eye and the sash of a window, to select a proper piece at once. Of course a plate accurately ground would be far better; the sides of common plates of such glass as I have had, are generally more or less wavy. The thickness of the first described form is 1^{mm}, it is so slightly wedged-shaped that the difference in thickness of the two ends very carefully

measured, I find to be only ·03mm, and when placed about half a meter from the eye, and three meters from the sash of a window, causes a displacement of the bar toward the refracting edge, apparently less than one-third the thickness of the glass; such a glass plate, it will be seen, cannot produce any sensible chromatic disturbance. This plate, cut and edges ground into an oval shape, and 65mm. in length, is placed at an angle of 80° with the axis of the tube, the refracting edge, or thinnest part, toward the eye. Immediately at the top of the tube which carries this plate, and which the plate crosses diagonally, is placed the side tube for the reflected rays, while a continuation of it receives the transmitted rays, the angle of inclination of the tubes is 20°; of course this angle will vary with the angle of the wedge and must be found by trial. Fig. 1

1.



2.



represents in section this form; *a b* is the glass plate, *c* the transmitted, and *d* the reflected ray. The cap of the eye-piece

B, contains a small prism, placed as represented, for redressing the reflected image; from this prism the reflected rays emerge, nearly parallel to the transmitted rays. The prism is small, and does not at all diminish the field of view; it has the effect of lengthening the path of the reflected rays so that although the eye-piece B is at a lower level than A, yet the tops of the caps of the eye-pieces are in the same plane and the union is easy with both eye-pieces. In this form, some means must be adopted of retaining the prism both with its reflecting face always parallel to the face of the plate *a b* when the eye-pieces are drawn out to vary the distance. The second form will probably be preferred; when the microscope is to be constructed as a permanent binocular, it is represented in fig. 2, *a b* is the glass plate, at the top of this plate a truncated rectangular prism *c*, is placed with its reflecting face parallel, but slightly inclined, to the face of the plate *a b*; the proper position is determined by experiment. It is so arranged that the images are the same in both fields; *d*, is the twice reflected, and *e* the transmitted ray. The eye-piece is placed *above* the prism in this case, and the prism is made sufficiently large to allow the use of the whole field; the eye-piece may be placed directly in contact with the prism if it is sufficiently large.

In both these forms, and they work equally well, the adjustment for different width of eyes, may be made by sliding out or in the two eye-pieces. It is quite true that when the images, reflected from the front and back of a thin plate of glass, are united by giving a slight inclination to these faces, i. e. making the plate very slightly wedge-shaped, that this union of images is only at a definite distance from the objective, and drawing out the eye-piece, should therefore give a slight overlapping of the images. Now this really does occur, but to so slight an extent as to be practically of no detriment. Indeed, it is entirely unpercieved with all classes of objects except one; when a number of very opake objects, e. g., thick scales from the wing of a butterfly lying close together, and upon each other, are shown upon a very bright field, the double reflection can be detected if the eye-piece is drawn out, or put in; beyond a certain point it vanishes entirely when the eye-piece is at the proper distance. I cannot, however, with the very highest powers on the diatomacea, or with lower powers on parts of insects, or the transparent injections, see any trace of it in the eye-pieces I have made, with all necessary change of eye-pieces to suit the ordinary varying distance of the eyes. It is obvious, that in the construction, fig. 2, the distance between the eyes may be allowed for, without sliding out the eye-piece by changing the inclination of the two tubes and rotating the

prism *c* on its axis, in this case, since the reflected ray *d* will travel over twice the angle which the prism is moved; some means, similar to that devised by Nachet, must be adopted for causing the prism, whenever the inclination of the two tubes are varied to suit different eyes, to move over just half the angle described by the movable tube. By this arrangement, the union of the two images from the two surfaces of the glass plate, will be quite undisturbed. It will be apparent that the glass slip *a b* may be turned aside, so as not to interfere with the use of the instrument as a monocular. I think, however, no one who has enjoyed the luxury of binocular vision, so complete as this is, will be disposed to return to the old form, for even with the common glass I have used, I can percieve no detriment to the definition, and but a trifling loss of light.

Art. VIII.—*On Wilsonite from St. Lawrence County, N. Y.;* by E. W. Root.

Under the name of Wilsonite, Dr. Sterry Hunt has described, in the Geological Survey of Canada, 1863, a mineral from Bathurst, C. W., which is principally a hydrated silicate of alumina and potassa. A short time since I found in the cabinet of Prof. Root of Hamilton College, several specimens of a mineral from St. Lawrence county, N. Y., resembling in appearance the pink scapolite from Bolton, Mass., but easily distinguished therefrom, by a much inferior grade of hardness. This mineral in its physical properties, action before the blowpipe, and behavior with acids, resembles precisely the wilsonite of Hunt. It occurs in peach-blossom red, prismatic masses, possessing two parallel cleavages at right angles to one another. Its hardness is about 3·5. Its specific gravity 2·77–2·78. Its luster is vitreous, and in thin fragments it is translucent. Before the blowpipe it fuses readily with intumescence to a white enamel. Concentrated acids decompose it, the silica separating in a pulverulent from. A qualitative analysis gave the same components as those of the Canada mineral, silica, alumina, lime, magnesia, potassa, soda, and water, with a trace of manganese. It also contained, quite intimately associated with it, some 15 per cent of carbonate of lime.

After removing the carbonate of lime with dilute hydrochloric acid, the mineral gave as the result of a quantitative analysis—

SiO_2	Al_2O_3	MgO	CaO	KO	NaO	HO	
47·46	30·51	3·63	0·53	8·78	2·43	6·09	= 99·43

These numbers agree quite closely with those of the following analysis of the Canada wilsonite by Dr. Hunt.

SiO_2	Al_2O_3	MgO	CaO	KO	NaO	HO	
47·70	31·22	4·14	0·39	9·38	0·05	5·35	= 99·13

The mineral analyzed by me was found several years since by Prof. Root near Oxbow on the road to the Rossie lead mines in St. Lawrence county. It occurs in connection with calcite, green hornblende (pargasite), and steatite (rensselaerite of Emmons,) while throughout the whole mass of the mineral small scales of graphite are disseminated.

There can be no doubt but the wilsonite of Hunt and this mineral are identical.

Wilsonite possesses a composition very similar to gieseckite, parophite, dysyntribite and agalmatolite. It is supposed by some eminent mineralogists to be an altered scapolite, while others consider it to have always possessed its present composition, and not to be the result of a metamorphic action.

School of Mines, Columb. Coll., N. Y., Nov. 11, 1867.

ART. IX.—*On the action of hydrated hypochlorous acid on Oil of Turpentine and Camphor;* by C. GILBERT WHEELER.

OIL of turpentine and camphor are chemically closely related, differing in composition by only a single molecule of oxygen.

$C_{10}H_{16}$ Oil of turpentine. $\qquad$ $C_{10}H_{16}O$* Camphor.

The intimate relation here indicated, has been by Berthelot clearly proven to exist, he having obtained camphor from oil of turpentine by combining the latter with hydrochloric acid, separating it therefrom as camphene—isomeric with oil of turpentine—and oxydizing platinum sponge.† Camphor may thus be considered as "Oxy-camphene." Dussart has recently claimed to have succeeded in obtaining camphor direct from oil of turpentine.‡

With regard to the relation of bodies to the homologous series of the fatty and aromatic acids it may be observed that where the number of molecules of carbon are the same, the members of the fatty series contain more hydrogen while those of the aromatic series contain less. Oil of turpentine, therefore, with its numerous isomerically allied bodies (terbenes), occupies a position intermediate between these two important

* C=12. O=16.

† Jahresbericht, 1858, p. 441.

‡ Zeitschrift für Chemie, 1867, 11.

groups of organic bodies, as the following example will illustrate:

$C_{10}H_{20}$	$C_{10}H_{16}$	$C_{10}H_{14}$
Diamylene.	Oil of turpentine.	Cymol.

That on the one side, oil of turpentine sustains the intimate relation to the aromatic series here assumed, has been by experiment abundantly illustrated. I need only to refer to the formation of terephtalic acid and nitrobenzol from oil of turpentine and the formation of cymol from camphor. The relations, however, to the fatty series of the bodies under consideration have not been thus satisfactorily demonstrated. Now oil of turpentine occupies apparently a similar position with reference to capric acid as acetylene does to acetic acid, as is herewith shown:

$C_{10}H_{16}$	$C_{10}H_{20}O_2$
Oil of turpentine.	Capric acid.
C_2H_2	$C_2H_4O_2$
Acetylene.	Acetic acid.

It appeared to me, therefore, to be a subject worthy of investigation to ascertain whether the relations above expressed could be proven by experimental research. I have for this purpose, made use of hydrated hypochlorous acid as a reagent, and have been able to obtain a substance which may be regarded as belonging to the series of the fatty acids.

If oil of turpentine (boiling point 159°) is added to a dilute aqueous solution of hypochlorous acid and shaken, it at once becomes yellow, thick and heavy, and soon settles to the bottom of the vessel. Were concentrated acid employed, the mixture would rapidly become heated and other products be formed than that sought, or, under the most favorable circumstances, but very little of the new body would be obtained. The oil should be slowly added, not allowing an increase of temperature, and ceasing when on adding a fresh portion, but slight change in color is produced, or before the characteristic odor of the hypochlorous acid can no longer be readily recognized.

The heavy oil is separated from the aqueous solution by filtration. The latter contains chlorid of mercury, originating from the oxyd of that metal employed in the preparation of the hypochlorous acid, also an organic substance, which, on evaporating the solution, separated as an oil with more or less decomposition. This is the most interesting of the products of the reaction, and in order to obtain it pure from the solution it is necessary to avoid the application of a high temperature.

To effect this, a quantity of common salt is added till the solution is saturated, which is then shaken with small por-

tions of ether. The etherial extracts are united and shaken with a concentrated solution of chlorid of ammonium, which takes up all the mercury chlorid, the ether is then removed with a pipette and chlorid of calcium added in order to effect its dessication. The filtrate is distilled and at the close of the operation a current of dried air is transmitted through the residue in order to more completely remove all traces of ether. The body thus obtained is the product of the direct combination of hydrated hypochlorous acid with oil of turpentine, and on its combustion I obtained the following results:

0·3450 gm. yielded 0·6190 gm. carbonic acid and 0·2340 gm. water.
0·2985 " " on ignition with lime, 0·3270 " AgCl.

These figures indicate the formula $C_{10}H_{18}Cl_2O_2$.

		Theory.	Found.
C_{10}	120	49·79	48·93
H_{18}	18	7·46	7·53
Cl_2	71	29·46	29·00
O	32	13·29	

This substance is therefore formed according to the following equation:

$$C_{10}H_{16}+2\left(\begin{matrix}Cl\\H\end{matrix}\right\}O\Big)=C_{10}\left\{\begin{matrix}H_{16}\\H_2\end{matrix}\right\}\begin{matrix}Cl_2\\O_2\end{matrix},$$

and judging from its empirical formula, might be viewed as bichlorinated capric acid; it, however, is entirely without the chemical characteristics that would appertain to such a body. We have rather here before us, the dichlorhydrin of a four-atomic alcohol, and which must beyond doubt be considered as belonging to the fatty acid series. Between this substance and that obtained by Neuhoff* from naphtalin there is the most complete analogy, as the following comparison illustrates:

$C_{10}H_{16}$ Oil of turpentine, (Terebentene).	$C_{10}H_{18}Cl_2O_2$ Dichlorhydrin of Terpen-alcohol.	$C_{10}H_{20}O_4$ New 4-atomic alcohol, (Turpen-alcohol).
$C_{10}H_8$ Naphtalin.	$C_{10}H_{10}Cl_2O_2$ Dichlorhydrin of Naphten-alcohol.	$C_{10}H_{12}O_4$ Naphtalin-alcohol, (4-atomic).

Dichlorhydrin of terpen-alcohol is a colorless, transparent, viscid substance, of a somewhat greater consistence than turpentine, completely neutral, difficultly soluble in water, but readily soluble in ether and alcohol. On heating its alcoholic solution with nitrate of silver, chlorid of silver is formed. It cannot be distilled, for before the necessary temperature is attained, decomposition commences and hydrochloric acid is given off. With nitric acid it is oxydized and yields a resinous mass.

* Zeitschrift für Chemie, 1866.

The above mentioned, as yet unknown, terpen-alcohol I attempted to obtain by treating the dichlorhydrin with baryta; however, there appeared to result a too energetic decomposition of the substance. I further tried the action of zinc and sulphuric acid, hoping to substitute hydrogen for the chlorine of the substance, was however, unsuccessful. I was, nevertheless, able to obtain with sodium a derivative of this dichlorhydrin. If sodium is added to the etherial solution, there is formed, after some hours, much chlorid of sodium and a yellow substance settles to the bottom of the vessel. If the whole is then treated with ether and the latter evaporated, there remains a thick mass which still gives a chlorine reaction. However, on digesting that portion not taken up by the ether with alcohol, filtering the same from the insoluble chlorid of sodium, the concentrated filtrate when slightly acidulated with sulphuric acid and shaken with ether, yields, on evaporating the etherial solution, a body containing no chlorine. This is insoluble in water, but soluble in alcohol and ether. It yielded no crystalline compounds with metalic bases, and its ammonia salt decomposed on evaporation. The lead, silver and copper salts, were amorphous powders, and the isolated acid could not be obtained crystallized, but only as a brownish translucent solid. On combustion I obtained from 0·1360 grm., 0·328 grm. carbonic acid and 0·1070 grm. water, which would indicate the formula $C_{10}H_{16}O_3$.

		Theory.	Found.
C_{10}	120	65·21	65·75
H_{16}	16	8·69	8·75

The formation of this acid can hardly be imagined to be the result of any very simple reaction; doubtless the dichlorhydrin, on parting with its chlorine, splits up into secondary products. As the quantity obtained of this body was but small, I was unable to study its chemical relations more completely. In view, however, of what shortly follows, and referring to the same, I would propose "Hydrophoronylic acid" or "Oxy-camphinic acid" as a suitable name for this substance.

Dichlorhydrin of terpen-alcohol is, however, only obtained in small quantities when oil of turpentine and hypochlorous acid are brought into contact. The chief product is the heavy oil first alluded to. A quantity of this was dissolved in alcohol, precipitated with water, redissolved in ether, dessicated, distilled, and thus obtained pure. The results on analysis were the following:

0·270 gm. gave 0·532 CO_2 and 0·177 H_2O=53·74 carbon and 7·28 hydrogen.
0·407 " " 0·800 " 0·255 " =53·61 " 6·92 "
0·340 " " 0·529 AgCl=38·36 chlorine.

These figures lead to no simple or at all probable formula; the body was possibly a mixture of mono- and trichlorinated oil of turpentine. A mixture of equal equivalents would demand 53·99 p. c. carbon, 6·08 hydrogen and 39·93 chlorine. This oil decomposed with evolution of hydrochloric acid on heating. It is also decomposed with formation of chlorid of potassium on digesting with an alcoholic solution of potassa. If it is heated for some time with nitric acid a small quantity of a volatile substance very irritating to the eyes is formed, together with a very considerable quantity of a resinous mixture from which was extracted with warm water, oxalic acid and another acid which slowly crystallized from the solution on standing. The crystals were readily soluble in ether and alcohol, and on ignition gave forth the odor of acetic acid. Dissolved in water and acetate of lead added, a salt was precipitated, which, on analysis, yielded 66·34 p. c. lead, 0·2805 gm. of substance giving 0·2725 sulphate of lead. Malonate of lead requires 66·99 p. c. of lead. From these various data, it became evident that the heavy oily substance formed from the oil of turpentine is a mixture, only that remaining in solution in the water present, being a simple body.

As we have seen that two molecules of hydrated hypochlorous acid unite direct to oil of turpentine, it appeared to me interesting in this connection to investigate whether chloric acid is capable of being similarly added, as Carius has succeeded in doing with benzol, obtaining the acid named by him trichlorphenomalic acid.* Carius employed a mixture of chlorate of potassa and sulphuric acid and proved that in the presence of benzol, the chloric acid is reduced to chlorous acid and the latter unites with the benzol direct. An analogous reaction appears to take place where oil of turpentine is employed. I obtained with turpentine a finely crystallized body which is perhaps the substance sought, having the formula $C_{10}H_{18}C_2O_4$. I hope to give this reaction a closer investigation.

At the outset, I referred to the intimate chemical relation existing between oil of turpentine and camphor, and with this in mind it may be interesting to investigate also the action of hypochlorous acid on camphor, a substance partaking on the one hand much of the nature of an aldehyd, and on the other, that of an alcohol. Its behavior on being treated with a solution of potassa in alcohol, splitting up into an alcohol (borneol) and an acid, resembles that of an aldehyd.† It does not, however, unite with bisulphites of the alkalies and it admits of having a molecule of hydrogen substituted for one of potassium

* Annalen der Chem. und Pharm., 1867.

† Berthelot, Annalen Chem. und Pharm., ci, 94.

or sodium, as is the case with the alcohols.* The true chemical structure of camphor must be determined by a further study of its derivatives.

While a dilute solution of hypochlorous acid acts readily and rapidly on oil of turpentine, its action on camphor is exceedingly slow. In the first experiment I allowed camphor to remain in a weak solution of hyponitrous acid for eight days, and thereupon one day in a concentrated solution. The product of the reaction, a white, indistinctly crystallized solid, was washed with water till no acid reaction remained, dissolved in alcohol and again precipitated by diluting with water. It still contained a small quantity of an oily substance, held mechanically, and which was removed by strongly pressing between filter paper. It was again crystallized and then was submitted to an analysis.

0·3255 grm. gave 0·6035 grm. carbonic acid and 0·178 grm. water.
0·4995 " " 0·611 " AgCl
0·260 " " 0·382 " "

From these figures the formula $C_2H_{27}Cl_5O_2$ may by calculated.

		Theory.	Found. I.	II.
C_{20}	240	50·37	50·57	
H_{27}	27	5·66	6·07	
Cl_5	177·5	37·27	37·63	37·11

The formation of this substance can be explained by the following equation:

$$2(C_{10}H_{16}O)+5ClHO=C_{20}H_{27}Cl_5O_2+5H_2O.$$

The result is a different and a much simpler one where camphor is immediately brought in contact with concentrated hypochlorous acid; it is at once transformed into a thick fluid, becomes warm, and after some time again hardens to a crystalline solid. This body is the chief product of the reaction, though a very small quantity of another organic substance is found in the solution. The crystalline substance is dissolved in alcohol, precipitated with water and thoroughly washed with cold water. It is then again repeatedly dissolved in alcohol and crystallized therefrom until obtained quite pure. On its analysis I obtained the following results:

0·2320 grm. gave 0·5940 grm. carbonic acid and 0·1710 grm. water.
0·2295 " " 0·1615 " chlorid of silver.

These figures correspond with those of simple chlorinated camphor.

		Calculated.	Found.
C_{10}	120	64·35	64·54
H_{15}	15	8·07	8·18
Cl	35·5	19·03	18·70

* Baubigny, Zeitschrift für Chemie, 1866, p. 408.

The following equation expresses the reaction:

$$\underset{\text{Camphor}}{C_{10}H_{16}O} + ClHO = \underset{\text{Mono-chlorinated camphor.}}{C_{10}H_{15}ClO} + H_2O.$$

Substitution products of this character appear in general to be the chief results of the action of the reagent here employed; addition products are formed only in small quantities. Carius obtained from benzol, monochlorinated benzol, together with a body named by him "trichlorhydrin der Phenose."* Monochlorinated camphor has not heretofore been obtained, though Clauss has obtained products containing four and six atoms of chlorine by the action of chlorine on camphor dissolved in trichlorids of phosphorus.†

Monochlorinated camphor is a white crystalline powder, soluble in ether and alcohol, insoluble in water. Its solution in concentrated alcohol on evaporation remains for a long time of a syrupy consistence; from dilute alcohol it crystallizes more readily and in very small, imperfectly formed needles. It melts at 95° C., is decomposed, with liberation of hydrochloric acid, at 200° C., and another substance, having an agreeable odor, is sublimed over. The taste and smell of this body are similar to ordinary camphor. It is acted on with difficulty by nitric acid even when boiling; by sulphuric acid it is dissolved at ordinary temperatures and again precipitated on dilution with water. With nitrate of silver its alcoholic solution yields chlorid of silver. Heated to 120° with concentrated solution of ammonia, chlorid of ammonium is formed and a derivate soluble in water. Treated with perchlorid of phosphorus there remained, after the removal of the oxychlorid of phosphorus formed, a substance which blackened on attempting to distill a portion. Its distillation was therefore not proceeded with, but it was washed with water, dissolved in alcohol and again precipitated by dilution. The oil-like substance thus obtained soon became a magma which yielded white crystals on pressing between filter paper. The substance was probably either the body $C_{10}H_{15}Cl_3$, or that resulting therefrom on subtracting one atom of hydrochloric acid, viz: $C_{10}H_{14}Cl_2$.

A considerable quantity of monochlorinate of camphor was treated with a solution of potassa in alcohol for 6 to 8 hours. The whole thereby became brownish-red and a large quantity of chlorid of potassium was formed. On dilution with twice its volume of water a voluminous precipitate (A) was obtained. The filtrate gave no precipitate on farther addition of water, and contained the potassa salt of a new organic acid. The latter was isolated on addition of sulphuric acid, then dissolved in

* Zeitschrift für Chemie, 1866, p. 67.

† Annal. Chem. und Pharm, cxxxvi, 323; xliv, 301.

ether, filtered, and thoroughly dried after evaporation of the ether. Its analysis yielded the following results:

0·2608 grm. gave 0·6318 grm. carbonic acid.*
0·2496 " " 0·6040 " " and 0·1870 grm. water.

These figures correspond with the formula $C_{10}H_{14}O_3$.

	Calculated.		Found.	
			I.	II.
C_{10}	120	65·93	66·07	65·99
H_{14}	14	7·70		8·23

The acid was neutralized with ammonia and acetate of lead added. 0·2240 grm. of the lead compound gave 0·1180 grm. sulphate of lead = 36·21 pr. ct. lead. The formula $C_{10}H_{13}PbO_3$, requires 36·42 p. c. The acid is therefore monobasic and has the following rational formula: $(C_9H_{13}O)\,CO\,.\,OH$. The radical requires one molecule of hydrogen in order to become phoron, and an experiment with a small quantity, by heating with lime, made it apparent that this substance was produced as it is in like manner from some other camphor derivatives. I therefore name this body phoronylic acid. Phoronylic acid is isomeric with camphoric acid ; it is a syrupy fluid, not soluble in water, readily soluble in ether and alcohol. It has but slight odor, somewhat resembling cumarin. This odor is especially marked when the substance is heated with sulphuric acid and chromate of potassa. The alkaline salts of phoronylic acid are readily soluble in water and appear not to crystallize; the ammonia salt loses its ammonia on evaporation. The salts of the heavy metals are insoluble.

The precipitate (A), mentioned in the foregoing, dissolved in alcohol, yielded on evaporation beautiful crystalline needles. Obtained pure by repeated crystallization and analyzed, the following were the results:

0·1970 grm. gave 0·5130 grm. CO_2 and 0·1659 grm. H_2O, which indicate the substance $C_{10}H_{16}O_2$.

		Calculated.	Found.
C_{10}	120	71·43	71·02
H_{16}	16	9·52	9·36
O_2	32	19·05	....
		100·00	

The reaction may be thus expressed:

$$\overbrace{C_{10}H_{15}ClO}^{\text{Monochlorinated Camphor.}} + KOH = \overbrace{C_{10}H_{16}O_2}^{\text{Oxycamphor.}} + KCl$$

Oxycamphor crystallizes in small white needles, is easily soluble in alcohol, insoluble in water, melts at 137°, may be sub-

* The hydrogen determination met with an accident.

limed without change, volatilizes somewhat even in boiling water and resembles ordinary camphor in taste and odor. Oxycamphor is isomeric with camphinic acid dicovered by Berthelot. According to that chemist, ordinary camphor on being heated with an alcoholic solution of potassa splits up into borneol and an acid which he presumed to have the composition $C_{10}H_{16}O_2$.* He did not analyze the acid but explained the process of its formation as follows:

$$\underbrace{2(C_{10}H_{16}O)}_{\text{Camphor.}} + KOH = \underbrace{C_{10}H_{18}O}_{\text{Borneol.}} + \underbrace{C_{10}H_{15}KO_2}_{\text{Camphinate of potassa.}}$$

It appeared to me desirable to analyze this substance and establish its isomeric character with oxycamphor. A quantity of camphor was therefore heated with an alcoholic potassa solution in a sealed tube to 180° for 6 to 8 hours. On opening the tube an inflammable gas escaped. (Probable H and CH_4 from decomposed alcohol.) The contents of the tube were diluted with water, the precipitated borneol and camphor filtered off and the filtrate completely neutralized with sulphuric acid. On concentrating till all the potassic sulphate had crystallized out, the mother-liquor was acidified with sulphuric acid, the precipitated camphinic acid washed with water, dissolved in ether and obtained therefrom by evaporation. The acid thus obtained corresponded completely with that described by Berthelot. It was an almost solid, "fast feste," transparent mass which, on account of its peculiar consistency, was very difficult to entirely free from moisture, and this doubtless accounts for the carbon determination in the subjoined analysis being too low. Nevertheless, there remains no doubt that the formula assigned to it is correct and that it is isomeric with oxycamphor.

The results of analysis were: 0·236 grm. substance, 0·610 grm. carbonic acid, and 0·211 grm. water.

		Calculated.		Found.
C_{10}	120	71·43	- - -	70·56
H_{16}	16	9·52	- - -	9·91
O_2	32	19·05	- - -	....

Camphinate of lead, dried at 100°, a white insoluble powder, yielded the following results on analysis:

0·1390 grm. substance gave 0·0787 grm. sulphate of lead = 38·77 p. c. lead. The theory calls for 38·26 p. c.

Camphinic acid is perhaps capable of yielding capric acid, or some body isomeric therewith, on submitting it to the action of nascent hydrogen.

A summary view of the established results of the foregoing

* Ann. der Chem. und Pharm., cxii, 364.

investigation and their closer allied chemical relations may be gathered from the following statement of formulæ.

Oil of turpentine=Camphene,	$C_{10}H_{16}$.
Camphor =Oxycamphene,	$C_{10}H_{16}O$.
Oxycamphor =Dioxycamphene,	$C_{10}H_{16}O_2=C_{10}\overset{H_{15}}{(OH)}O$
Camphinic acid,	$C_{10}H_{16}O_2=(C_9H_{15})CO.OH$
Oxycamphinic acid (hydrophornylic acid),	$C_{10}H_{16}O_3=(C_9H_{15}O)CO.OH$
Phoronylic acid,	$C_{10}H_{14}O_3=(C_9H_{13}O)CO.OH$
Monochlorinated camphor,	$C_{10}H_{15}ClO$
Terpendichlorhydrine,	$C_{10}H_{18}Cl_2O_2$

In closing, I acknowledge with pleasure the valuable service in connection with the foregoing, of my assistant, Mr. Oscar Loew.

Nuremberg, June, 1867.

ART. X. — *On the Oxydation of Diamylene with Chromic Acid;* by J. WALZ, Ph.D.

AT the instigation of Prof. Erlenmeyer (in Heidelberg), who proposes to ascertain the relative constitution of Diamylene, I undertook the oxydation of this substance with chromic acid.

I used amylene which boiled between 35° and 40° C. This was polymerized rapidly and completely according to the method described by Erlenmeyer* and almost the whole of the product thus obtained, distilled at 153°–170° C. In order to test its purity it was treated with bromine in a narrow tube which was surrounded by cold water; the bromine was added gradually, every drop added causing a hissing sound and a considerable evolution of hydrobromic acid.† When the liquid had assumed a reddish-brown color it was purified, washed and dried according to the usual methods. The product thus obtained was not Bauer's bibromid ($C_{10}H_{20}Br_2$),‡ but the *monobromid of diamylene bibromid*, $C_{10}H_{19}Br_3$. It is an almost colorless oil, heavier than water and has a weak, but not disagreeable odor of camphor. It decomposes and turns brown at 100° C. It was analyzed with the following results:

* Verhandlungen des naturhistorisch medicin. Vereins, Heidelberg, vol. iii, 1865–6.

† Although the temperature of the liquid during the operation was about 15° C., no carbonization could be observed. Compare: Bauer, Sitzgsberichte der Wiener Akademie, xliii, 96.

‡ C=12, O=16, S=32, &c.

I. 0·2235 grms. of the substance furnished 0·2541 CO_2 and 0·1063 H_2O.

II. 0·2093 grms. furnished 0·2472 CO_2 and 0·1007 H_2O.

	$C_{10}H_{19}Br_3$ demands:	Found. I.	II.
C,	31·66	31·00	32·20
H,	5·01	5·28	5·34
Br,	63·33		
	100·00		

The oxydation.—At one time 14 grms. of diamylene were mixed with 100 grms. of bichromate of potassa, 150 of sulphuric acid (spec. gravity=0·1842) and 150 of water; in a second experiment 32 grms. of diamylene, 228 of the bichromate and 442 of sulphuric acid and of water, each, were employed, these quantities being required to supply 10 atoms of oxygen. This mixture was put into a spacious glass-balloon, which was connected with a reversed "Liebig's cooler" and was shaken until the substances began to act upon each other. The reaction soon became very intense, the liquid fairly boiling, and large quantities of carbonic acid being evolved. When the reaction had somewhat subsided, the oxydation was completed with the aid of a lamp; but in neither case was all the chromic acid reduced. The contents of the balloon were then diluted with water and distilled, furnishing a green oil and a few drops of an oily acid; the water which distilled over contained also a great deal of acid. A greenish resinous mass remained behind in the balloon, floating on the surface of the liquid.

The green oil.—Immediately after distillation this oil seems to hold some acid in solution; it was, therefore, neutralized with soda, washed with water and dried over chlorid of lime. In this way about 12 c.c. m. of the oil were obtained from 32 grms. of diamylene. It has no fixed boiling point, the thermometer rising from about 128° to 200° C. during its distillation. The following are the results of various analyses:

I. 0·1006 grms., taken from the entire quantity of the oil after drying with chlorid of calcium, yielded 0·2643 grms. CO_2 and 0·1206 H_2O.

II. 0·0996 grms., boiling at 140°–160° C., yielded 0·2690 CO_2 and 0·1236 H_2O.

III. 0·1646 grms., boiling at 160°–180° C., furnished 0·4552 grms. CO_2 and 0·1974 H_2O.

IV. 0·2016 grms. boiling at 180°–200° C., furnished 0·5667 CO_2. The determination of the water was lost.

	I.	II.	III.	IV.
C,	70·39	72·75	75·41	75·54
H,	13·30	13·75	13·32	....

			C.	H.
The formula	$C_7H_{14}O$	requires	73·68	12·28
" "	$C_8H_{16}O$	"	75·00	12·50
" "	$C_9H_{18}O$	"	76·05	12·67
" "	$C_{10}H_{20}O$	"	76·92	12·82

It would, consequently, appear most likely to consider this oil as a mixture of these various oxyds and as perhaps still containing diamylene which had not been attacked during the process of oxydation. It possesses a yellowish-green color, a penetrating odor of camphor and of mint; its specific gravity is less than that of water; it does not combine with bisulphite of soda and it is in no way affected by a temperature of 20° C. It appears to be difficult to dry it completely with chlorid of calcium, and sodium cannot be employed because it affects the oil chemically.

Hoping to obtain some farther information concerning the constitution of this substance, or, at least, to purify it by oxydizing the diamylene which it possibly still contained, I treated 6 grms. of the oil with 5 grms. of bichromate of potash, 8 grms. of concentrated sulphuric acid and 16 of water in a glass balloon connected with a reversed 'Liebig's cooler.' The course of this oxydation resembled exactly that of diamylene itself; the formation of acids, both oily and soluble in water, and of a resinous substance took place, while about 4 grms. of the oil, which still possessing the characteristic smell and color, now showed the following composition:

I. 0·0907 grms. of the substance yielded 0·2536 CO_2 and 0·1104 H_2O.

II. 0·1098 grms. of the substance yielded 0·3046 CO_2 and 0·1435 H_2O.

	I.	II.
C,	81·69	81·53
H,	13·52	13·53

This composition answers very nearly to the formula $C_{20}H_{40}O$ (which would be the oxyd of tetramylene) which requires 81·08 p. c. C, 13·51 H, and 5·41 O. Still it would seem as if merely a farther oxydation of the products intermediate between the diamylene and the acids described further on, had taken place in this instance, and, consequently, no definite formula can as yet be assigned to this oil.

The acid distillate.—The acid distillate, mentioned above, was neutralized with soda and evaporated to dryness. A considerable quantity of a salt, part of which proved to be deliquescent, was obtained in this way. It was decomposed with

sulphuric acid and distilled, furnishing an oily acid and water of a strongly acid reaction. The oily acid was separated and collected by itself and found to be a colorless syrup which shows no sign of crystallization at a temperature of 20° C. It was exactly neutralized with ammonia and precipitated with nitrate of silver. The precipitate formed a white, cheesy, voluminous mass, which is almost insoluble in water. Two analyses showed that the dry salt contained 40·66 and 40·88 p. c. of silver.

I. 0·1773 of the salt yielded 0·0721 = 40·66 p. c. Ag.
II. 0·1634 " " " 0·0668 = 40·88 " "

This composition would correspond to several salts, and we prefer, therefore, to leave the final decision to further investigations.

The water which distilled with the foregoing acid had a sour reaction and the smell pointed to the presence of acetic acid. It was several times partially neutralized with nitrate of silver, and the salts which crystallized out, were analyzed:

I. 0·1589 grms. of the dry salt left 0·1021 = 64·25 p. c. Ag.
II. 0·1698 " " " " 0·1086 = 63·95 " "
III. 0·1232 " " " " 0·0794 = 64·44 " "
IV. 0·2328 " " " " 0·1505 = 64·65 " "

Acetate of silver requires 64·67 p. c. Ag.

The salt analyzed under IV had been obtained as follows: the liquid was left in contact with the oily acid for several days, and shaken with it from time to time in order to dissolve as much of it as possible; it was then separated and subjected to a fractional distillation, which was suspended as soon as oily acid ceased to distil. The liquid which remained behind in the retort was neutralized with nitrate of silver while it was still hot, and on cooling down, a beautiful crystallization of acetate of silver was obtained. The purity of the salt, as disclosed by analysis, proves the absence of any acid intermediate between acetic acid and the one before described. I must mention yet that the amount of acetic acid formed is very large.

The tarry substance.—The tarry substance which I have mentioned above as having remained behind in the balloon after the distillation of the other products of oxydation, was boiled with dilute sulphuric acid and alcohol, the solution poured off and the chromium precipitated with soda. The solution was decanted from the precipitate* and evaporated to

* This precipitate was decomposed with sulphuric acid and a great deal of a tarry substance was thus obtained floating on the liquid. It is soluble in alcohol and ether, but insoluble in water. When the precipitate is boiled with a concentrated solution of pure potassa, sesquioxyd of chromium is precipitated and a yel-

dryness on the water-bath. A deliquescent salt remained behind which was decomposed with sulphuric acid and yielded an oily acid. This acid is a colorless syrup which does not crystallize at 50° C.; it possesses an agreeable fruit-like odor, is lighter than water, little soluble therein, and seems to have the formula $C_7H_{14}O_2$ (perhaps isomeric with œnanthylic acid). On account of the small quantity at my disposal I could not accurately determine its boiling point; but this seems to lie between 215°–225° C. The salts which this acid forms with the alkalies are very soluble in water and deliquesce in contact with the air.

The lime salt is very easily soluble in water; in the dessicator (over sulphuric acid) it dries up, forming a white, anhydrous, crusty mass, which is not deliquescent.

The silver salt is obtained as a flocculent white precipitate. Its composition was ascertained to be as follows:

I. 0·1471 of the dry salt left 0·0667 = 45·34 p. c. Ag.
II. 0·1078 " " " 0·0486 = 44·79 " "
III. 0·1727 " " " were subjected to combustion, furnishing 0·2245 grms. of CO_2 and 0·1046 H_2O.

Required by the formula $C_7H_{13}O_2$.				I.	II.	III.
C_7	84	35·44	p. c.	....	....	35·45
H_{13}	13	5·49	"	....	....	6·71
Ag	108	45·57	"	45·34	44·79	....
O_2	32	13·59	"	....	....	....
	237	100·00				

In conclusion, I beg leave to state that want of time and material prevented me from extending my experiments far enough to speak with greater certainty on many points touched upon in this article. Experiments in this direction will, however, be continued in the Laboratory of Prof. Erlenmeyer (Heidelberg), to whom I take this opportunity of expressing my heartfelt thanks for the kind interest and valuable advice which he bestowed upon me during the whole of my investigation.

New York, Nov. 18th, 1867.

lowish oily-looking substance appears which is easily soluble in water. Sulphuric acid decomposes it, and on distillation an oily acid is obtained which seems to be homologous to the above-mentioned acids. The quantity which I obtained of it was not sufficient for an analysis. These acids appear to me to be identical or isomeric with caprylic acid and its next higher homologues.

ART. XI.—*Preliminary notice of a remarkable new genus of Corals, probably typical of a new family*, forwarded for study by Prof. J. D. Whitney, from the Silurian rocks of Nevada Territory; by F. B. MEEK.

AMONG some fossils sent on for investigation, by Prof. Whitney, the State Geologist of California, from the Silurian rocks of Nevada,* there are a few specimens of a new genus of corals, presenting such an extraordinary and interesting combination of characters, that it is thought desirable to call attention to it here.†

The specimens of this fossil contained in the collection, are slender, slightly flexuous, arched or nearly straight, and subcylindrical, excepting near the lower end, where they taper to a point, by which they were probably attached. They may have grown in tufts or groups, but all the specimens yet seen are single, and show no evidences of growing in contact.

To the unassisted eye, the external surface of these corallites, with the exception of obscure annular swellings and constrictions of growth, and faintly marked linear septal costæ, seem to be nearly or quite smooth. When examined under a strong lens, however, it is seen to be beautifully punctate; the punctures being minute, of exactly uniform size, and arranged with mathematical regularity in quincunx, and so closely crowded that the little divisions between them are scarcely equal in breadth to the punctures themselves, and form, as it were, an extremely delicate kind of net work. So remarkable is the appearance of this punctured outer wall, that the first question that suggests itself, on examining it under a magnifier, is, whether or not it may be merely and exceedingly delicate Polyzoon encrusting the whole surface. A clear examination, however, especially in carefully prepared transverse sections, show that the punctures actually pass entirely through the wall, which is very thin, and that they are not due to the growth of the Polyzoon, nor to surface ornamentation.

On grinding away this very thin punctured wall, the septa are seen immediately within, to be stout, equal, straight and very equidistant, but in grinding a little farther in, they are observed to become very regularly waved laterally, *exactly like the septa in the foraminiferous genus Fusulina.* So striking is this resemblance, that it was not until after ascertaining

* A notice of the discovery of Silurian rocks at this distant western locality has already been published by Prof. Whitney in the Proceedings of the California Academy of Sciences.

† Figures and descriptions of this and the other Silurian fossils from this locality will be given in the second volume of Prof. Whitney's report on the geology of California.

from cross section, that the fossil has not an involuted structure, that I could get rid of the suspicion that it might be a new type of *Foraminifera* allied to *Fusulina*, instead of an extraordinary coral.

By grinding still farther in (to a depth of about 0·06 inch, in a specimen 0·34 inch in diameter), the lateral waving of the septa already mentioned, is seen to be there suddenly, and so strongly marked, that they connect laterally, in such a manner as to form a kind of complex inner wall between the great central cavity and the outer septate zone. This wall, however, does not completely isolate the septate outer zone from the central cavity, but is perforated by a series of round equal canals, very regularly placed one within each of the lateral curves of the septa, so that those on the opposite sides of each septum alternate with exact regularity, as do those of each of the two rows within each interseptal space. These canals have no similarity to the minute punctures of the outer wall, being greatly larger and very differently arranged. They do not pass *directly* through the inner wall, but are directed obliquely upward and inward, so that as seen in transverse sections of the corallites, they present the appearance of a double row of vesicles cut across.

Both longitudinal and transverse sections show the large central cavity to be without any traces of septa or columilla. From these sections, I was likewise at first led to believe this central portion to be also an entirely open cavity or calice, the whole length of each corallite, but on sending specimens to Prof. Verrill, he called my attention to some obscure appearances of transverse plates in one of the specimens cut longitudinally, and requested me to cut others with the view of ascertaining whether or not these are plates. A longitudinal section of another specimen, however, when carefully polished, reveals no traces of proper transverse plates; but when examined by the aid of a strong magnifier, it shows the whole interior to be occupied by a dense vesicular tissue, the walls of the vesicles being of extreme tenuity. This structure is seen in the interseptal spaces of the outer zone, as well as in the central cavity within.

In regard to the affinities of so remarkable a type, it seems scarcely safe to express an opinion without a better series of specimens for study. Some of its internal characters, as suggested by Prof. Verrill, would seem to indicate remote affinities to the *Cyathophyllidæ*; but its peculiar perforated outer wall would, on the other hand, appear to remove it from the primary division of corals including that family.

I am therefore led to believe it a new genus, and most prob-

ably typical of a new family, in which opinion Prof. Verrill concurs with me. For this genus I would propose the name *Ethmophyllum.*

Among the specimens in the collection under examination, there are apparently two species of this fossil. That considered the type of the genus is larger and more robust than the other, and more conical in form, especially near its smaller end. None of the specimens seen are quite perfect at the larger extremity. One measures 0·37 inch at its imperfect larger end, and seems to have been 2½ to 3 inches in length. In this there are sixty septa, while its outer septate zone is 0·07 inches wide. Another fragment, however, measures 1·20 inch in diameter at the larger end, and was probably 5 to 6 inches or more in length, with 112 septa at the larger end. This large fragment shows that the septate outer zone does not increase in thickness or breadth in proportion with the size of the corallites, since it is only 0·15 inch broad in this specimen, the increase in thickness of this corallite being made up by the increased size of the non-septate interior. For this larger species I would propose the name *Ethmophyllum Whitneyi*, in honor of Prof. J. D. Whitney, to whom I am indebted for the use of the specimens.

Of the other species I have seen but a single specimen, which is imperfect at both extremities, about 2·15 inches in length, and only about 0·20 inches in diameter at the larger end, and 0·15 at the smaller, with some 24 to 28 septa. In addition to its much more slender form, it differs from the other species in having its septa so strongly waved laterally, as almost to divide the interseptal spaces into cells, nearly to the outer wall. For this, if it should prove to be a distinct species, I would propose the name *Ethmophyllum gracile.*

The specimens were all obtained at Silver Peak, Nevada, and were discovered by Mr. Clayton.

ART. XII.—*Note on the shell structure and family affinities of the genus Aviculopecten;* by F. B. MEEK.

IN several former publications, I have alluded to the analogy, in some of their characters, between the genera *Aviculopecten* and *Pterinea;* particularly in the nature of their broad, furrowed cardinal plate or area, without any well defined cartilage pit. After examining the shell structure of several species of *Aviculopecten*, sometime since, without being able to detect any traces of the peculiar prismatic outer layer, so char-

acteristic of the various genera of the *Aviculidæ*, I was led to regard this group as most probably belonging to the *Pectinidæ* and as holding in it a somewhat parallel position to that of *Pterinea* in the *Aviculidæ*.

Some examinations, however, that I have recently had an opportunity to make, of the structure of several species of *Aviculopecten* apparently in a good state of preservation, collected by the Nebraska survey under the direction of Dr. Hayden, seem to show that these shells have (when well preserved) an outer prismatic layer of shell as in the *Aviculidæ*, and not the structure of the *Pectinidæ*.

The little experience I have had in making such examinations of the structure of fossil shells, has led me to the conclusion, that *negative evidence* should be received with great caution in such cases, since these shells very often have the structure entirely obliterated during the process of fossilization. In addition to this, it is probable that they are liable to have the very thin outer prismatic layer entirely exfoliated, so as to leave the surface markings tolerably well defined on the laminated portion just within, which is then very apt to be mistaken for the original surface of the shell. Those I have just examined, with one exception, appear to consist entirely of the thin outer layer, the laminated inner portion having been doubtless dissolved away after the shells were embedded in the matrix. They consist of the following species, and show what I am led to regard as a prismatic structure very clearly, viz., *Pecten neglectus* and *P. Hawni* Geinitz; both of which have all the external characters at least, of the genus *Aviculopecten*, and of course are not true Pectens; also *Aviculopecten Coxanus* M. & W. and *A. occidentalis* Shumard, the latter being well known to have the flat striated cardinal plate and internal characters, as well as all the other peculiarities of the typical Aviculopectens. The others are as yet only known to me from what is believed to be the outer layer alone, which is too thin and fragile to bear polishing, but when a fragment is carefully cleaned with a camel hair pencil, and examined under the microscope, by transmitted light, the structure alluded to can generally be seen with little difficulty, without any farther preparation. In these, I have not seen the flattened cardinal plate of the genus, but its absence is doubtless due to the fact that it was mainly or entirely composed of the wanting inner laminated portion of the shell.*

* The only source of doubt in regard to the structure mentioned being really that of an outer prismatic layer, is, that the same has also been seen in the only remaining portion of *Lima retifera* Shumard, from the same bed. This shell is also very thin, and the portion mentioned has all the appearances of being the *outer* layer. In *Lima*, Dr. Carpenter found the *outer* layer to be laminated, and the *inner* to be perforated with tubuli. The question is, whether the structure I have seen is organic, or minutely crystalline.

ART. XIII.—*Correspondence of Prof.* JEROME NICKLÈS, *dated Nancy, France, Oct.* 22, 1867.

On some new Fluorids.—While examining some time since the haloid compounds corresponding to the oxyds of a higher order, I made* the discovery that the periodids are less stable than the perbromids, which in turn are less so than the corresponding compounds of chlorine or the perchlorids. These last are the most stable, so much so in fact, that some of them do not act upon gold, while the corresponding compounds of bromine and iodine dissolve this metal with varying facility. From this fact the stability of these compounds may be concluded to stand in inverse ratio to the weight of the equivalent of the halogen which they contain. Another conclusion seems to be derived from these researches, that a tendency to depart from the character of a neutral body and act the part of an acid is developed along with the stability; this is one of the results from my researches on the perchlorid of lead. Fluorine having a lower equivalent than chlorine, I have endeavored by way of control to obtain certain of its combinations which correspond to chlorids or bromids already recognized and studied. The following will show that these new compounds all act like acids. Take for example iron. Sesqui-iodid of iron,† Fe^2I^3, has so little stability that it decomposes spontaneously, giving out iodine; and it constitutes, therefore, a good solvent for gold.‡ Bromid of iron, Fe^2Br^3, has much more stability and Fe^2Cl^3 does not decompose when heated, and will even form double salts, (for example, $2KCl+Fe^2Cl^3+2HO$, of Fritsche. Now I have found that the sesquifluorid of iron is still better fitted to form saline combinations, or fluo-salts, as they are called by Berzelius, who made known a compound, $3KF+Fe^2F^3$, and another $2KF+Fe^2F^3$. I have obtained analogous compounds, both with sodium and ammonium, and with such alkaloids as quinine and brucine. These double salts are more or less soluble in water; at the boiling temperature they decompose, leaving yellow ferruginous flakes. With acetate of lead they give a white precipitate which becomes yellow on heating; on the contrary, the white cloud caused by the nitrate of lead does not become yellow, but dissolves under the influence of heat. Nitrate of bismuth has no effect in the cold, but on heating gives a white precipitate. Ferrocyanid of potassium throws down a blue precipitate, but the sulpho-cyanid of potassium has no action, at least not until the acid Fe^2Fl^3 is displaced by treating its combination with

* This Jour., II, vol. xliii, p. 94. † Ib., vol. xli, p. 108. ‡ Ib., vol. xliii, p. 95.

alcohol charged with fluo-silicic gas; in this case, the red color is obtained which characterizes sulpho-cyanid of iron. However, this red color disappears in the presence of an alkaline fluorid; there is formed a white cloud composed of one of the before mentioned fluo-salts, and the liquid contains an alkaline sulphocyanid. Acetate of iron is equally discolored under these circumstances. On operating with fluorid of potassium and concentrated solutions, all the iron is precipitated in the condition of fluo-salt; with liquids more dilute, a little iron always remains in solution.

Prussian blue is equally decomposed by the fluorid of potassium, provided a boiling temperature is used. An excess of fluorid of potassium also opposes its formation. Tannin also does not precipitate ferric-salts in the presence of alkaline fluorids; and fluorid of potassium destroys the black color produced by it. This enables us to distinguish ink prepared with nutgalls from that made with aniline colors, or with indigo-carmine. Tannin does not act on sesqui-fluoferrate of potassium, but it precipitates the corresponding ammonium salt. I may add that the precipitate formed by the yellow prussiate is not only blue, but it has a very decided violet tinge. This action may be utilized in the making of colors.

In view of the facility with which *ferricum* separates from all its combinations, when it finds itself in the presence of an alkaline fluorid, it is necessary to admit that the sesquifluorid of iron is a decided acid, a fact which is confirmed, moreover, by its readiness to form saline combinations, with the fluohydrates of the organic bases. What I have just said of iron is equally true of manganese. I have obtained compounds having for their formulas $KFMnF^3$, KFMnFO, $2KFMn^2F^2O$, NH^4FMnFO, and in which the fluorid of manganese evidently plays the part of an acid. I shall speak of it in greater detail at another time, only observing now that the perfluorid of manganese seems destined to solve the problem of fluorine, by putting into the hands of chemists a simple and expeditious process for its isolation.

On the pretended diffusion of copper in nature.—The presence of copper has been noticed in many substances since the time (1818) when Bucholz discovered it in the ashes of plants. When, in 1844, Walchner found copper in muddy deposits from mineral springs, it was not long before it was detected in small quantities in the waters themselves. Very recently, a chemist has found it in repeated trials in the mineral waters of Bourbonne, Balarne, etc.,* while another has discovered this metal everywhere and in all mineral and organic substances in which

* Jour. Pharm., IV, iv, 22.

he has looked for it. The process which has led to this wonderful result offers nothing new. Let it be added, however, that the author referred to worked with reagents, the purity of which he had carefully tested and found to be free from copper. The evaporations and calcinations were performed in a platinum dish with a Bunsen's burner.* Impressed with this wonderful diffusion of a metal which is found everywhere save in the reagents employed for finding it, I could not help recalling the process used formerly for the detection of fluorine,† and I was led to a like conclusion as regards the diffusion of copper. In a word, it appeared to me that there was some source of error, and if it was not in the reagents, it must be found in the apparatus, especially the apparatus used for the incineration. "In fact, the Bunsen burners are generally of copper. This metal is said to be volatile when heated in a current of gas. Besides, when such a burner is lighted, the flame is often seen colored blue by the copper which is volatilized."

These remarks in my *Revue des travaux de Chimie*,‡ are founded on facts long since known and utilized in my laboratory, and which experiments upon artificial light, with which I have been occupied, brought to my attention. They have just been confirmed by Lossen,§ who has found that in fact Bunsen's burner is the true source of the copper that has been discovered in many of the residues from incinerations; for in experimenting with a large number of organic substances, Lossen has, in fact, obtained either some or no copper according as he made his incinerations with a copper, or a glass burner (or one free from copper). Now that this cause of error is found out, many results are explained that appeared strange when they were announced. Of this kind is the grain of copper which Gahn obtained, on reducing to ashes, before the blowpipe, a piece of paper. The fact of normal copper, that is to say, copper in the blood, may be admitted, if the presence of copper in mineral waters is established. But it is necessary to receive with reserve the assertions with regard to copper-bearing mineral waters, inasmuch as the analysts were not aware of the source of error here mentioned.

Magnetic phantoms.—In my work on Electro-magnets, I have stated a process enabling us to fix and preserve the figures which magnets produce when iron filings are subjected to them. These figures are known in France by the name of phantoms, a name given them by the physicist Haldat, of Nancy. To fix them, the phantoms are developed upon a sheet of paper covered over with wax or stearine, then, a little dis-

* Jour. prakt. Chem., xcv, 368.
† This Jour., II, xxi, 395.
‡ Jour. de Pharm. et de Ch., IV, ii, 412.
§ Jour. de Pharm. et de Ch., IV, iv, 21

tance above, something is placed sufficiently hot (a cover of a crucible for instance) to melt the wax or fatty substance. This last, when made liquid, rises by capillarity between the grains of the filings, and if the substance is then removed the fatty matter solidifies, sticking together all the metallic particles. These plates can be kept in a frame and under a pane of glass, where they will not be rubbed. They can also be superposed upon one another without injury.

To preserve these curves better, the following process has just been contrived, which gives very good results. The author of it is Stanislas Meunier, assistant naturalist at the Museum. The papers on which the phantoms are to be developed is first impregnated with ferrocyanid of potassium. It is then dried and placed above the magnet used in the experiment. The phantom is then developed as before, except that in place of iron filings, magnetic iron sand is employed, a fine variety of which comes from Norway. Over the phantom thus developed, is passed for a very short time (a few seconds) a small quantity of chlorhydric gas, which is received from the upper part of an inverted tunnel, placed above the phantom. As soon as the chlorhydric gas has acted, the iron sand is removed, and the sheet of paper is washed in a large quantity of water. It is then seen that each grain of magnetite has produced a small blue circle on a clear blue ground; and the points together give all the details of the phantom in consequence of the blue compound developed by the decomposition of the yellow prussiate. The plate thus obtained is very strong; once dry it can be placed in a book and preserved indefinitely. It might be thought that iron filings would be better for this process. But Mr. Meunier has found that magnetite is really preferable, since it is not attacked by chlorhydric gas; metallic iron gives chlorid of iron, which soils the proof and can be removed only by many washings. Magnetite, on the contrary, is free from this objection; it serves to condense the chlorhydric gas through a kind of capillary action, and to accumulate it around the points where magnetic attraction has accumulated the most of the iron sand.

For a long time the magnetic phantom was only an object of curiosity. But since the applications of electro-magnetism have become numerous, these phantoms have been found to be very useful. We learn from them, whether the poles of a magnet are, or have been, isonomal or antinomal, isodynamic or heterodynamic, with "points consequents" or not, bifurcate, trifurcate, tubular, circular, etc.*

* This Jour., II, xxx, 413.

On the presence of the vapor of water in certain stars.—In the course of his researches on the spectrum of the vapor of water, Janssen thinks he has noticed its presence in several of the stars, among them, Antares, the spectrum of which presents very plainly the lines and bands of the vapor of water. These lines are black, very broad, and have the characteristic position. Janssen has taken into account the error proceeding from the moisture of the air. On the heights of Mt. Etna the air was very dry. The stations where he has made trials are, Etna, Palermo and Marseilles. Janssen has observed evidence of the presence of the vapor of water also in the atmosphere of Mars and Saturn.

On the transparency of the air.—The inhabitants of valleys know that one of the surest signs of rain is the clearness of outline and blue color of the distant mountains. It indicates great dampness in the air. But it may be asked, how does it happen that this dampness aids the transmission of light, while it hinders that of radiating heat, as Tyndall has shown. This question, raised by de Saussure, has again been theoretically solved by Col. Jackson. According to him, the watery vapor dissolves the impurities which are mingled with the air, and thus renders it very transparent. Entering into these ideas, and recalling the large proportion of atmospheric dust of all kinds which later works have made known to exist, De La Rive has concluded that not only does the atmospheric dust become transparent on absorbing the watery vapor, but that further, the water absorbed renders the dust heavier and makes it fall to the ground. De LaRive also admits that if the presence of watery vapor renders the air transparent when it contains dust or organic particles, its presence is no longer necessary for this end in the absence of dust. This explains why in winter, mountains appear so clearly at a distance, even when the air is very dry; why the air is so clear over plains of snow, and why it is always the same on the Peak of Teneriffe in consequence of the east wind. In the warm season, and in the months when organic life has the greatest activity, the air is most charged with this kind of dry vapor, which in calm weather diminishes in so wonderful a manner the visibility of distant objects. Of the various kinds of dust, only those which are soluble in water, for example, common salt, according to Bunsen, are always in the air, even in regions remote from the coasts. These are the kinds of dust which contribute to the fertilization of the soil: a chemist, Barral, has even found phosphates.

According to a meteorologist, Marshal Vaillant, atmospheric refraction has very much to do with these phenomena. In the

hot seasons, the air is warmed by contact with the soil, expands and changes its density and refracting power, effects which do not happen when the air is cold. These considerations have induced De LaRive to include the transparency of the atmosphere in the list of meteorological elements, to be regularly observed in order to establish the precise relations which exist between this particular element and all others, such as the pressure, temperature, moisture, the hour of day, and epoch of the year; a kind of observation of interest not only to science, properly so-called, but also perhaps to medicine. With the aid of Mr. Thury, De LaRive has had constructed a photometer designed to measure the variations in the transparency of the air at different seasons. It was made by the instrument makers of Geneva, and has already been for some time in use.

Physiological effect caused by the vapor of mercury.—We learn from Faraday that mercury is volatile at the freezing temperature in a confined atmosphere. The chemists of Holland have observed that an atmosphere becomes destructive to plants if it contains vapor of mercury. The same chemists have recognized that sulphur constitutes a sure antidote in this case. On repeating and confirming these experiments, Boussingault found that the neutralizing effects of the sulphur lay in the formation of sulphuret of mercury. The plants sensitive to mercury resist its action and continue to flourish, if their leaves have just been sprinkled with sulphur. In this case the sulphur at the end of a month takes a dull grayish appearance, due to the sulphuret produced. Sulphur is doubtless a little volatile at the ordinary temperature, and the tension of its vapor is not appreciable; but the results obtained show that the tension is not nul; and as the densities of the two vapors are nearly the same, and as the equivalent of mercury is nearly six times that of sulphur, it is evident that one volume of sulphur is enough for nearly six volumes of vapor of mercury. In an atmosphere where there is vapor of mercury, the sulphur in fragments acts like flowers of sulphur. It becomes covered with grayish spots; then after eight or ten days, the surface takes the appearance of iron; it is covered over with sulphuret of mercury, very adherent, not soiling the fingers, and not easily rubbed off. Boussingault has been able by this means, to give a metallic look to objects cast in sulphur. Observing the vegetable cell languishing in an atmosphere containing traces of vapor of mercury, and on the other hand, seeing the sulphur in a still less quantity dissipating the unhealthfulness caused by the mercury, Boussingult asked himself whether something similar did not take place in the ethereal ocean. "If

the poisonous agent, of which the air is the vehicle, is a metal like mercury or some deleterious gases, such as the miasma which emanates from marshes, may we not regard as purifying agents, the sulphur, iodine, ozone, whose presence at times in the atmosphere cannot be questioned."*

Acclimatization of the Ostrich.—We have spoken several times of the attempt made by the society of acclimatization, at different points on the globe, to propagate the ostrich, the feathers of which are so much sought for in commerce. The park for acclimatization at Grenoble has reared several ostriches. But a disease has appeared among them, which has made it necessary to kill quite a number of them. Their legs became weak and unable to support them. Evidently the conditions necessary for the life of the animal, which require much air and liberty, have not yet been realized. The feathers of the killed ostriches have always been very readily received by commerce, and their flesh is good eating. At the Cape of Good Hope, the acclimatization of the ostrich gives very good results, but the feathers are worth about 20 per cent less than those of the wild ostrich.

At Madrid the trials are very encouraging. At the park of Retiro and of Casa del Campo, where there are sandy hills, brooks, trees and pastures, already several generations of ostriches have been grown. But there, as at Grenoble, the ostriches often break their limbs from the weakness of the bones; and the eggs of the birds are also very fragile. It has been remarked that ostrich feathers are of the greater value where there are less woods and thorns in the places where these birds live. It is on this account that the ostriches of the Cape furnish feathers of medium quality, for they are torn off by the thick woods of the region. The farther we go toward the north in the desert and the dry and barren country, the better are the ostrich feathers.

On fossil man.—Sir Charles Lyell in his work "On the antiquity of man proved by Geology," in chap. xv, mentions only two discoveries of human remains in the Alpine diluvium or Post-pliocene, so abundant in the valley of the Rhine, and especially at Alsace, in the two districts of the *Haut-Rhin* and *Bas-Rhin*. The first is that of a portion of a human skeleton found in 1823, by Boué, near the village of Lahr, on the right bank of the Rhine. The bed containing these bones was the alpine diluvium in question (the loess). This diluvium was in an entirely undisturbed state, and presented its characteristic fossil shells. The history of this discovery is known. Cuvier, to whom they were submitted, on recognizing that they were human remains,

* Journal de Pharm. et de Chimie, Sept. 1867.

expressed the opinion that they were from a modern cemetery. This rich collection was consequently neglected and is now lost.

The second was that of a lower jaw-bone with its teeth, found near Maestricht, on the right bank of the Meuse, while sinking a canal. The cut traversed a terrace of gravel covered by loess to a depth of 18 meters, 6 of which were in the loess and 12 below it, in the stratified gravel. In the chasm, great numbers of bones of elephants, oxen, deer and other mammals, were found. The human jaw bone, which is preserved in the museum of the University of Leyden, was obtained at a depth of 5·7 meters, at the contact of the loess and the gravel in an undisturbed bed of sandy clay resting on the gravel.

In the loess of Alsace there have been found, at several localities, fossil bones of animals in large numbers. A naturalist of Colmer, Dr. Faudel, has just found near this village, and in the undisturbed loess, a frontal and a right parietal belonging to the same skull. The spot was in the loess, at the bottom of a trench of five meters. The deposit had there the usual appearance, being undisturbed and in place, without any trace of cracks, or of infiltrations derived from above, and preserved its homogeneity perfect, quite to the superficial vegetable layer from which it was distinctly separated. A large quantity of bones of deer, cattle, elephants (*Elephas primigenius*) and bison were obtained. As to the human skulls, the superciliary regions were quite prominent; the depression between the frontal bones and the superciliary prominence was strongly pronounced, and the frontal sinuses very large. This prominence of the superciliary arches makes the forehead appear more depressed than it actually is; the facial angle could not be measured; Dr. Faudel estimated it at about 75°. On uniting the two bones, the general form of the skull appeared to be prolonged from before backward, a little depressed laterally, and related to the dolichocephalous type. It may be remarked that a part of these characters have been observed also in the skulls of the cavern d'Engis near Liege, of Neanderthal, near Dusseldorf, and in one of the crania of the mounds of Bozzeby in Denmark; and all of them in a skull found in the diluvian sand of Ingelheim and presented to the session of German Naturalists at Giessen in 1864. These fragments of fossil man have been deposited by Dr. Faudel in the museum of Colmar, where many naturalists have examined them.

Universal Exposition of 1867.—Among the novelties that may be seen at the Exposition, are those which relate to primary education. Reports were called for by the minister of public instruction, Mr. Duruy, not only from the primary schools

of France, but also from those of other nations. The objects exhibited are of the following kinds:

1st. Specimens of work by the pupils of the primary schools, (penmanship, calculation.)

2d. Plans for the building of school houses.

3d. Drawing by pupils of the primary schools.

4th. Books, apparatus and methods of instruction; general pedagogy; plans for lectures; methods of reading; of writing; of instruction in arithmetic, history, and geography; and instruction in singing.

5th. Instruction in agriculture and horticulture.

6th. Instruction in Natural History.

7th. Needle work of the girls' school.

8th. Arrangement and furniture of salles d'asile.

9th. School libraries.

10th. Gymnastics.

A commission chosen from among the most competent men was charged to classify and examine all the objects. The reports made on this occasion have been printed by the order of the Minister, and form an octavo volume, which is not on sale, but is distributed by the Ministry of public instruction. The work concludes with plates, giving plans for the construction of school houses, including model plans which have been considered the most appropriate for the end proposed. There are also the plans presented by other nations. Finally, there is an interesting report on the protection afforded to children employed in industrial or agricultural work. The Industrial Society of Mulhouse has undertaken this protection on a large scale, and without government intervention. It serves to incite the other industrial villages to similar provisions for the working classes.

Another part of this Exposition relates to the publication of maps in relief of the various chains of mountains in France. They have been made with the greatest possible care, and after a new plan, by Mr. Bardin, Chief of the geographical works at the Polytechnic School. Mr. Bardin has called his work, *Topographie enseignée par des plans-relief et des dessin.* The works and numerous reliefs are exhibited at the Invalides, in the Vauban hall. They will remain there on exhibition during all next year.

Banquet of Chemists.—On April 22d, while the Universal Exposition was in progress, the French chemists offered to the learned strangers a fraternal Banquet. More than 300 persons took part there. Although the *fête* is called "Banquet of Chemists," there were also present physicists, mineralogists,

and geologists. The meeting was presided over by the two princes of chemistry, Dumas and Liebig. Toasts were offered by Dumas, Liebig, Balard, and Hoffmann. The presiding officer read a letter written by Chevreul, honorary president, as *Doyen d'age* of living chemists, born August 21, 1786, and professor of chemistry since 1809.

Notwithstanding the difficulty of arranging such a Universal Exposition, because of the great number of exhibitors, the Germans wish to take their turn, and five years hence there may be a universal exposition at Berlin. The present one at Paris covers all the Champs de Mars, an extent of about 112 acres. It is calculated that, as a consequence of the progress of the industrial arts, it would require, five years hence, 150 acres. Berlin has not 150 acres of land, any more than Paris, or London ; and it is possible that it will be necessary to restrict the number of departments, instead of admitting all as heretofore.

Bibliography.—*Traité d'algèbre à l'usage des Candidats aux écoles du gouvernment;* by H. LAURENT, teacher of analysis at the Polytechnic School. One vol. 8vo, 1867. Paris, (Gauthier-Villars).—We have already announced some of he works of H. Laurent, son of the Chemist, Auguste Laurent. He promises to do for mathematics, what his father did for chemistry. More fortunate than the latter, he obtains at least justice among his cotemporaries. His labors in the department of mathematical analysis have earned him the position, which he holds in the polytechnic school.* While developing in his work the programme of study required to enter the military school, he has also introduced new views, and made an entirely original work, which will be followed with profit both by the scholar and teacher. The work is from the press of Gauthier-Villars, successor of Bachelier, who has no rival in France in the printing of mathematical works.

Elemens d'Electro-chimie appliquée aux sciences naturelles et aux arts; by M. BECQUEREL. 2d edit., 1 vol. 8vo, 628 pages. —The first three books in this volume treat of the production of electricity. Then comes electro-chemistry, properly so called, then "les actions lentes," through which the author has realized such interesting discoveries. The work ends with some of the applications of electricity, and especially the electro-chemical treatment of ores, and methods of protecting metals from the corrosive action of sea water. In spite of his 79 years, the illustrious inventor of the constant battery is always at his laboratory at the Museum, and adds each day a

* This Journ., II, xvi, 103.

new result to his favorite science of electro-chemistry, to which he has rendered so great services.

Review of Geology for the year 1864 *and* 1865; by A. DELESSE and DE LAPPARENT. 1 vol. 8vo, 279 pages.—This interesting publication appears now for the fourth time. By the care which the authors use to join the facts which they bring forward to those which have been presented in the preceding volumes, they have been able to make this series a history of the progress of geology since 1860. The work is divided into four parts; 1st, Preliminaries; 2d, Rocks; 3d, Rock formations; 4th, Descriptive Geology. The rocks have been especially treated of by Delesse, whose valuable works on the subject are well known; de Lapparent has had charge of the formations; and the other parts have been prepared by the two authors in common.

Les Lois économiques par A. DE METZ-NOBLAT. 1 vol. 8vo, 739 pp.—This volume is a résumé of the course of political economy which the author presented in 1865 and 1866, at the University of Nancy. Little cared for by despotical governments, political economy is a science quite new among the French. It is very little taught in France, and it is only two years since a chair of Political Economy was first established in the Faculty of the Law School at Paris. A. de Metz-Noblat has founded the department at Nancy, and pursues it there with great success. The beautiful volume of which we give account, introduces the reader in a very complete manner, to the science as established by Sully, Colbert, Vauban, Adam Smith, Malthus, Turgot, Condillac, Condorcet, J. B. Say, Ricardo, MacCulloch, and other celebrated names.

La Science et les Savants en 1866, *par* VICTOR MEUNIER. 3d year, 1867.—The author exhibits here the same spirit and nerve as in the preceding volume, (this Jour., vol. xli, p. 110). The principal subjects are Heterogeny; Ante-historic times; fabrication of diamonds; aërial navigation; the whole enriched with curious biographical facts for any who are interested in the scientific movement of our times, and the men who cultivate the sciences. Some months since, also, Victor Meunier became publisher in chief of the Cosmos. He impresses his energy on this periodical. At this moment, he is exposing the abuses which have crept into the French scientific organization — abuses which, in fact, are inherent in all human works.

ART. XIV.—*A new Meteoric Iron from Mexico;* by J. LAWRENCE SMITH, Louisville, Ky.

A FRAGMENT of this meteoric mass was placed in my hands by Dr. Joseph Leidy, of Philadelphia, with the following statement of its history:—"Sometime ago, the American Philosphical Society deposited its natural historical collection with the Academy of Natural Sciences. In the collection of minerals there was a special lot of Mexican minerals presented by Mr. Poinsett, who was at one time U. S. Minister to Mexico. The minerals consisted of rich silver ores, &c., among them this specimen of meteoric iron, which was labelled 'native silver, Mexico.' It appeared to be an entire meteorite, exhibiting no where a cut or broken surface; one end, however, was much crushed, as if the specimen had been used for a hammer. The present weight of the specimen is 3,600 grains; it is two inches long, one and a half wide, and one and a half high in the middle, and slopes irregularly toward each end. The face from which the piece sent was cut is hexagonal, and exhibits a partial crystalline arrangement without development by an acid."

Its structure is highly crystalline, and on the cut face of the piece I have, the laminæ of the crystals are over $\frac{1}{16}$ of an inch thick and cross each other at the usual angle. The Widmannstättian figures are very strongly developed by acid. Its sp. grav. is 7·72, and its composition shows the usual constituents in the following proportions:

Iron,	91·103
Nickel,	7·557
Cobalt,	·763
Phosphorus,	·020
Sulphur,	*trace*
Copper,	*trace*

Although this specimen is spoken of as being a complete meteorite, it not unfrequently happens that fragments of larger masses of meteoric iron of a very highly crystalline structure, which have been detached for some time, present the appearance of being complete masses. It is possible that this iron may be a portion of the large mass recently sent to France from Mexico by Gen. Bazaine.

Art. XV.—*Shooting Stars on the morning of November 14th, 1867.*

On the morning of the 14th of November, the periodic meteors were witnessed throughout the whole of the Western Continent. The following accounts give the character and extent of the display. By previous arrangement, the hours from $10\frac{1}{2}^h$ P. M., to 2^h A. M., were designated for concerted observations for parallax. It was thought that the meteors would be less numerous then than later, and hence more easily identified, and that conformable meteors would be seen at more stations, since their paths would be more nearly horizontal and longer. The publication of these observations for parallax is postponed until they can be compared and reduced.

The air was clear, in most places, though floating clouds concealed some of the meteors. The moon was but two days past the full, and hence the numbers seen, and the brilliancy of the exhibition, were very greatly diminished.

1. *At New Haven.*—At New Haven there were two parties, one upon the roof of Sheffield Hall, composed of Prof. Lyman, Prof. Whitney, Dr. Wright, and several assistants; and the other composed of students of the College, under the direction of the writer, and located upon the tower of Graduates' Hall. The first party gave exclusive attention to observations for parallax, the second counted the numbers visible, although some paths were charted by Mr. O. M. Harger, and the places of some others indicated with more or less precision.

Upon the tower of Graduates' Hall during the first part of the night, that is, from twenty-eight minutes past nine until one o'clock, we had about five observers counting. Each of them had assigned to him a quarter of the heavens to which he was to look. The counting was aloud to avoid duplication. The following was the result for the several quarter hours:

	9 h.–10 h.	10 h.–11 h.	11 h.–12 h.	12 h.–1 h.
1st quarter hour,	..	2	1	10
2d " "	..	2	3	4
3d " "	3	2	2	6
4th " "	0	3	7	2
Hourly number,	6	9	13	22

The total number seen in $3^h\ 32^m$ was 47. Soon after midnight a dense cloud arose in the west, and before the close of the hour, it had nearly covered the sky.

At one o'clock a new party of observers replaced the former one, and from this time until five o'clock we had about fifteen

observers. The first quarter hour was therefore somewhat interrupted by the change of watch, but the clouds were even a greater hindrance. The following were the numbers counted in successive quarter hours:

1^h	0^m	to	1^h	15^m	7	meteors;	sky about	$\frac{3}{4}$	covered.
	15	"		30	12	"	"	$\frac{1}{2}$	"
	30	"		45	12	"	"	$\frac{1}{4}$	"
	45	"	2	0	30	"	"	$\frac{1}{4}$	"
2	0	"		15	40	"	"	$\frac{1}{4}$	"
	15	"		30	41	"	"	$\frac{1}{3}$	"
	30	"		45	45	"	"	$\frac{1}{3}$	"
	45	"	3	0	23	"	"	$\frac{1}{2}$	"
3	0	"		15	38	"	"	$\frac{1}{3}$	"
	15	"		30	82	"	"	$\frac{1}{5}$	"
	30	"		45	145	"	"	$\frac{1}{10}$	"
	45	"	4	0	242	"	"	$\frac{1}{10}$	"
4	0	"		15	302	"	"	nearly	clear.
	15	"		$27\frac{1}{2}$	462	"	"	"	"

At four o'clock we were frequently losing meteors in our count in consequence of two or more appearing at the same instant in different quarters of the heavens. The errors from this cause increased until at $4^h\ 27\frac{1}{2}^m$ it was evident that our results would not be comparable with those obtained elsewhere, nor would they furnish a reliable measure of the intensity of the display. We therefore ceased counting in concert.

At $4^h\ 30^m$ one person counted 21 in one minute.

At $4^h\ 32^m$ the whole company counted silently for one minute. They gave severally the following numbers of meteors seen; viz., 32, 64, 31, 24, 56, 34, 90, 48, 37, 38, 32, 25. Average 42·6.

At $4^h\ 34^m$, in another minute the results were, 52, 45, 29, 22, 80, 42, 37, 56, 24, 42, 58, 52, 38, 36; average 43·8.

At $4^h\ 40^m$ they counted aloud, all together, 60 in a minute.

At $4^h\ 43^m$ they counted silently with the following results for the several persons: 32, 34, 25, 30, 15, 17, 16, 20, 15, 25, 44, 27, 26, 19: average 24·6.

At $4^h\ 48^m$ the whole company counted aloud in one minute 36 meteors. At $4^h\ 53^m$ a silent count gave the following results for the different persons, viz: 23, 13, 12, 9, 14, 20, 14, 12, 14: average 14·6.

At $4^h\ 57^m$, one person counted 11 in a minute.

At $4^h\ 59^m$ ten persons counting singly for 65 seconds saw severally, 12, 7, 11, 10, 9, 10, 17, 15, 13, 9; average per minute 10·4.

At $5^h\ 8^m$, seven persons saw severally in a minute, 9, 10, 11, 7, 8, 16, 8; average 9·9. At $5^h\ 15^m$, four persons counted severally in a minute, 4, 3, 7, 4; average 4·5.

At $5^h\ 18^m$, seven persons, counting aloud, saw 10 meteors in the minute. At $5^h\ 28^m$ three persons saw singly in the minute 1, 2, 1 ; average 1·3. At $5^h\ 30^m$, four counting aloud saw 11 in all. The dawn was at this time just beginning to add to the moonlight its influence in diminishing the visibility of the meteors.

In order to compare the various numbers in these observations it is necessary to reduce them to a fixed interval, and to allow for the cloudiness of the sky, and the numbers of observers. For the latter purpose I have taken the numbers in columns B and C on page 194, vol. xli, of this Journal, combined them, and changed their form, so as to make the number of meteors seen by a single person in a given time the unit. The following table is the result.

No. of obs.	Met. seen.	No. of obs.	Met. seen.	No. of obs.	Met. seen.
1	1·00	5	3·28	9	4·15
2	1·88	6	3·58	10	4·31
3	2·47	7	3·80	11	4·47
4	2·93	8	4·00	12	4·63

The table may be interpreted thus: eight persons looking toward different portions of the heavens so as to divide the sky symmetrically among them will see four times as many meteors as the average number seen by them individually. I moreover infer from the rate of increase of the numbers that fifteen observers will see five times as many as one.

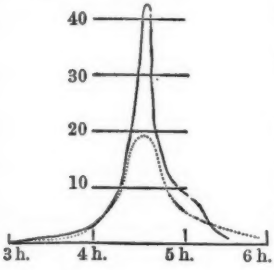
Making allowance thus for the number of observers, and the cloudiness of the sky, I have constructed from our observations the following table. In the column "No. of meteors," I have given the number visible per minute, by a single person at the time indicated (N. H. m. t.)

Table showing the number of meteors per minute visible at New Haven by a single observer during the night of Nov. 13th–14th, 1867.

Time.	No. of met'rs.	No. of Obs.	Time.	No. of met'rs.	No. of Obs.	Time.	No. of met'rs.	No. of Obs.	Time.	No. of met'rs.	No. of Obs.
h. m.			h. m.			h. m.			h. m.		
9 36½	·06	5	12 7½	·20	5	2 37½	·71	15	4 40	12·0	15
52½	·00	5	22½	Too cloudy for estim'n		52½	·62	15	43	24·6	14
10 7½	·04	5	37½			3 7½	·76	15	48	7·8	12
22½	·04	5	52½			22½	1·36	15	53	14·6	9
37½	·04	5	1 7½			37½	2·01	15	57	11·0	1
52½	·06	5	22½	·24	15	52½	3·23	15	59	10·4	10
11 7½	·02	5	37½	·21	15	4 7½	4·03	15	5 8	9·9	7
22½	·06	5	52½	·53	15	21½	6·16	15	15	4·5	4
37½	·04	5	2 7½	·72	15	31	21·00	1	18	2·6	7
52½	·14	5	22½	·73	15	33	42·6	12	28	1·3	3
						35	43·8	14	30	3·8	4

According to this table one person should have seen a little more than three hundred meteors between $1^h\ 10^m$ and $4^h\ 27\frac{1}{2}^m$.

Several of the company reported the numbers seen by them individually during that time as follows, 380, 330, 191, 180, 276, 335, 92, and 72. The last two were rejected as being exceptional from some cause, and the remainder give an average of 282. An allowance for cloudiness would make the two numbers agree.



The full line in the diagram represents the numbers in the above table. The dotted line represents the numbers deduced similarly from the observations at the Toronto observatory, given below.

During the whole time from $1^h\ 10^m$ to 5^h, the following numbers were seen by individuals of the company, viz: 813, 888, 635, 913, 790, 737, 792, 600, and 408; average 731. More or less time in the height of the shower was lost by every one. If we allow for this cause, for cloudiness, and for the hour from 5 to 6 o'clock, it is reasonable to assume that the number for one person for the five hours between 1^h and 6^h would be at least 900. This implies about 5000 for the total number visible in the moonlight. The moon, however, must have concealed one-half or three-fourths of the whole number. But for that cause there might have been 10 or even 20 thousand visible.

Very few indeed of the meteors moved in paths which would not, if produced backward, cut across the quadrilateral ε, γ, μ and ζ Leonis. I watched carefully those which moved in parallels of latitude, and every one seen went accurately from the center of the quadrilateral. Those which went in circles of latitude were not however from a point, but from a line of from three to five degrees in length. One end of this line had nearly the longitude of ζ Leonis and the other had a longitude one or two degrees greater than that of ε and μ Leonis.

I suspected a tendency of the eye to carry back the more distant tracks to parts of this line too near the zenith. The eye cannot judge accurately of the proper allowance for the apparent curvature on the heavens of an arc of a great circle, when that arc is very nearly horizontal. The nearer tracks, I thought, clustered in the parts of the line near *zeta*. The latitude of the line is about 10° 15′. The longitude of the eastern end is less than 145°; that of the western end more than 140.°

Nearly all the bright meteors left the characteristic phosphorescent train. The few unconformable meteors seen were strikingly different in appearance from the conformable ones.

In a few instances, the train lasted for minutes. As the clock struck four, one left a train visible more than four minutes; how much longer I cannot say, as my attention was then diverted. It floated eastward two or three degrees.

2. *At New Haven.*—Prof. Twining furnishes the following observations which are of special value on account of the great care with which he observed and discussed the great shower of 1833.

"After half past three o'clock on the morning of the 14th, I did not again observe the meteors until five o'clock, and, consequently not until their frequency had become very much less than in the interval. Still they were, even then, more numerous than I had witnessed since 1833. In from 5^h to 5^h 10^m I counted not less than fifty that were conformable, and from that to 5^h 22^m, 50 more,—making 100 (and probably two additional) in 22^m. Afterward, from 5^h 40^m to 5^h 45^m, there were seen but 13, and in the following five minutes, to 5^h 50^m, only 4. The meteors at five o'clock, compared with those at three o'clock, had no observed difference of magnitude, or flight or duration of trains. From these and the more extended observations of others, made public at New Haven and elsewhere, it appears obvious that the *scale* of this display, compared with what was observed by myself and a multitude of others in 1833, was not—at a rough estimate—more than about one-fifth. This estimate has respect to each of the three following particulars, viz: the frequency of the meteors protracted through a long time; the massive character and brilliancy of the longest and largest; and the duration of the main body or shower. In respect also of the entire agregate of numbers the disparity would appear much greater still. In 1833 there were not less than five hours of full development; while the same this year was but a single hour. Again, in 1833, the *frequency*, prevailing through two hours or more, was estimated by competent observers to from 10,000 an hour to several times that number. Ten thousand an hour was, no doubt, an over cautious estimate; while the aggregate number of 200,000 in seven hours, assigned by Professor Olmsted, although at the other extreme, appeared finally—so far as my own observations and investigations at the time could determine—very much nearer to the truth. Again there were, in this display of 1833, occasional meteors which surpassed, almost immeasurably, any August or November meteors seen in the United States since that occurrence. One such occasional meteor was witnessed by myself, and described at the time; and I saw in the northeast, not long before sunrise, more than one so brilliant and large as to show a well defined circular and fiery disc through

the dense glow of twilight which made the train invisible. By a few observers, meteors were seen in the zenith after the sun had risen.

"A remark may be appropriate here respecting the recurrence of November meteors which was witnessed extensively in the eastern hemisphere. The various statemets of this recurrence furnished by competent and eminent observers in Great Britain and on the continent, especially the Astronomer Royal of Scotland and Professor Grant of Glasgow,—also those published in the London Times of Nov. 15th,—and the letters of American missionaries in Turkey and Syria, repeat in description so variously and exactly the massive, brilliant and characteristic features of the meteoric shower in this country, thirty-three years before, that all who carefully observed the latter would, on comparison, no doubt agree that the phenomena of 1866—especially as seen in Syria—were substantially a reproduction of the like in 1833. It does not appear, however, that they were, on the whole, equally extensive and magnificent. On the contrary it is evident that the shower of 1866, at the places from which we have authentic accounts, was inferior to that of 1833, in duration at least, and in the frequency and aggregate number of the meteors,—unless the letter of Dr. Pratt from Marash, in Turkey, to Professor Newton, shows an exception in Western Asia."

3. *At New Haven.*—Prof. Loomis watching alone counted 500 in one hour.

4. *At Germantown, Pa.*—Mr. B. V. Marsh, at Germantown, counted as many as 20 per minute, but had gone into the house at the moment of maximum display. His nephew, Mr. R. M. Gummere, watching with him, reported 39 in one minute as the greatest number seen by him.

5. *At Haverford, Pa.*—Prof. Samuel J. Gummere, of Haverford College, reports about 1000 meteors seen between half past 11 and 4 o'clock. The time of maximum frequency was thought to be a little before half past four. At $4^h\,25^m$ one observer saw 140 meteors in one minute; four, five, or six, being often visible at once. The total number at this time was estimated at from 3 to 5 per second.

6. *At Toronto, Canada.*—The following is an extract from a letter of Mr. G. F. Kingston, Director of the Magnetic Observatory.

"In the paper which I send herewith, I have given the number of shooting stars, during each interval of 10 minutes, together with the average amount of cloud during the interval, expressed in terms of the hemisphere.

"With a view of catching any stragglers in the outskirts of the stream, a watch was kept through the night of Nov. 12th,

but the sky was perpetually overcast. Prior to 1h A. M., on Thursday, Nov. 14, the sky was nearly overcast, and about 20 meteors only were seen between midnight and 1h A. M. At 1h10m systematic counting was commenced from the top of the observatory by four observers working simultaneously. The observers were students of University College, Toronto, several of whom remained through the night in the building, relieving each other from time to time on the tower. Nearly all the meteors proceeded in directions which, when produced backward, passed through the constellation Leo; only about two per cent being not conformable.

"Many were brilliant in spite of the moonlight, but there were no audible detonations.

"Thursday night it was mostly overcast till 4h A. M., on Friday. Between 3h A. M., and 4h A. M., 11 shooting stars were counted by one observer, but none subsequent to 4h A. M., although the sky then became very favorable. The rapid falling off in the numbers between 5h A. M., and 6h A. M., on Thursday, for which the increase in the cloudiness was insufficient to account, shows, I think, that the earth was approaching the outer boundary of the denser portion of the stream."

Abstract of the number of shooting stars seen at the Magnetic Observatory at Toronto, Nov. 14th, 1865.

Portion of the hour.	1 h. to 2 h.		2 h. to 3 h.		3 h. to 4 h.		4 h. to 5 h.		5 h. to 6 h.	
	No. seen.	Cloudiness.	No. seen.	Cloudiness.	No. seen.	Cloudiness.	No. seen.	Cloudiness.	No. seen.	Cloudiness.
m. m.										
0—10	0	0·7	18	0·0	39	0·0	354	0·2	65	0·3
10—20	6	0·7	21	0·0	46	0·0	430	0·2	48	0·4
20—30	4	0·6	24	0·0	61	0·0	237	0·2	42	0·5
30—40	10	0·2	16	0·0	108	0·0	145	0·2	19	0·6
40—50	6	0·1	23	0·0	126	0·0	96	0·2	13	0·7
50—60	18	0·0	21	0·0	180	0·1	83	0·2	8	0·6
Total,	44		123		560		1345		195	

Grand total, 2267

Between 12h and 1h, A. M., the sky being mostly covered with clouds, 20 meteors were seen. The dotted line in the cut on page 81 represents the observations in this table.

7. *At New Bedford, Mass.*—Mr. Robert B. Taber gives for the different intervals the following numbers seen by him alone at New Bedford.

Time.	Meteors seen.	Time.	Meteors seen.	Time.	Meteors seen.
2h 00m to 2h 15m	15	4h 25m to 4h 30m	97	5h 00m to 5h 05m	140
35 " 55	20	30 " 35	87	05 " 10	81
3 37 " 3 55	54	38 " 40	48	10 " 15	70
4 00 " 4 10	50	40 " 45	266	15 " 20	35
10 " 15	40	45 " 55	276	20 " 25	34
15 " 25	108	55 " 5 00	110	25 " 40	52
				45 " 6 13	43

8. *At Hartford, Conn.*—Mrs. J. H. Trumbull and Miss Trumbull from two (closed) windows, one looking east with a range of 130°, and the other almost exactly covering the N. W. quadrant, began to count a few minutes after four o'clock, and completed their tale of 500 a few minutes after five, the count occupying very nearly one hour. Of course looking through glass the smaller ones were many of them lost. Mrs. Trumbull at one time saw five in motion at one instant.

9. *At Chicago, Ill.*—Prof. T. H. Safford reports the following number of meteors seen at Chicago on the morning of the shower. There were from 8 to 30 observers.

From	12^h	0^m	to	2^h	20^m	128	meteors	were	seen.
"	2	20	"	2	53	143	"	"	"
"	2	53	"	3	30	653	"	"	"
"	3	30	"	4	12	1529	"	"	"
"	4	12	"	5	45	857	"	"	"

Total, 3310.

One observer looking to the zenith, counted 420 between 3^h 30^m and 5^h 45^m A. M. These are reported as not included in the preceding count. Prof. Safford noticed that, as nearly as he could estimate, from one-fifth to one-sixth of the stars visible to the naked eye on a moonless night could be seen on that morning.

10. *At Evanston, Ill.*—Mr. Francis Bradley and Mr. Henry Bannister began their watch upon the roof of Heck Hall, about half past twelve A. M., of the 14th, Mr. Bradley looking toward the N. E. and E., and Mr. Bannister toward the N. and N. E. They counted as follows:

	From 12½h. to 1 h.	1h. to 2h.	2h. to 3h.	3h. to 3½h.	3½h. to 3¾h.
Mr. Bradley,	6	27	102	102	738
Mr. Bannister,	2	13	61		
Total,	8	40	163	102	738

	3¾h. to 4h	4h. to 4¼h.	4¼h. to 4½h.	4½h. to 5h.	
Mr. Bradley,	171	170	61	29	
Mr. Bannister,	98	94	18	21	
Total,	269	264	79	50	In all 1713.

The attention was almost exclusively given to counting, and the numbers are therefore the more valuable. The unconformable ones were very few, not much more than a dozen in all. Two left trains that lasted for three or four minutes. The prevailing tint in all was blue. Many were brick-reddish, while a few were of the latter color on the outside of the train, and bluish in the middle. Mr. Bradley gives the center of the radiant, R. A. 9^h 51^m, Dec. +23. He was looking at the radiant, and saw quite a number of paths within the bend of

the sickle, but none of them absolutely stationary like some seen last year.

The numbers seen at Evanston correspond very well with those seen at New Haven. The latter part of the Toronto curve in the diagram on p. 81 represents, however, the variation in the numbers toward the end of the shower better than the corresponding portion of the New Haven curve.

11. *At Ann Arbor, Mich.*—Prof. Watson was prevented by the high wind, which was blowing almost a gale, from making complete observations. The number of meteors counted was as follows:

From	3^h	45^m	to	3^h	55^m,	230 met'rs.	From	4^h	15^m	to 4^h 25^m,	230 met's.
"		55	"	4	5	185 "	"		25	" 35	115 "
"	4	5	"		15	250 "	"		35	" 45	78 "

At times the flight of meteors was so incessant that only a portion could be counted. Prof. Watson noticed particularly that in the vicinity of the radiant point the light of the meteors was of a sea-green tint, with occasionally strong tints of the blue. The position of the radiant point he found at half past four to be R. A. 150° 45′, Dec. + 21° 55′.

12. *At Bloomington, Indiana.*—Prof. T. A. Wylie, assisted by students of the Indiana State University, watched from 9^h P. M. to 5^h A. M. After midnight hardly a star under the second magnitude could be seen in any part of the heavens. It remained nearly uniformly hazy with some slight alterations until morning. From 9^h to 12^h but one meteor was seen; from $1^h$to 2^h, 18; from 2^h to 3^h, 43; from 3^h to 4^h, —276; from 4^h to 5^h, 184. The whole number of meteors counted was 535. Taking into account the state of the air and the light of the moon, they were sure that the tenth, and believe that the fifteenth part were not seen. The greatest number seen in a given time was from 3^h 35^m to 3^h $36\frac{1}{2}^m$, averaging $14\frac{2}{3}$ per minute.

From	3^h	37^m	to	3^h	39^m	they saw	3 per minute.	
"		39	"		40	"	5	"
"		40	"		41	"	6	"
"		41	"		46	"	$11\frac{3}{5}$	"
"		46	"		47	"	11	"
"		47	"		50	"	10	"
"		50	"		55	"	7	"
"	4	0	"	4	5	"	$4\frac{2}{3}$	"

One meteor was noticed by Prof. Kirkwood apparently stationary.

13. *In Alleghany Co., N. Y.*—Mr. J. N. Flint at Canaseraga, counted 460 in the hour from half past four to half past five o'clock.

14. *At Topeka, Kansas.*—Prof. John D. Parker saw 30 in the quarter hour from 5^h to $5\frac{1}{4}^h$ A. M., and 31 in the next quarter hour.

15. *Albany, N. Y.*—The following account of the observations at the Dudley Observatory is furnished by the director, Mr. G. W. Hough.

"On the night of the 12th Nov. a general watch was kept up, but as it continued cloudy during the whole time, no meteors could be seen. On the night of the 13th, however, it was perfectly clear until $11\frac{1}{2}$ P. M., after which until $3^h\ 45^m$ A. M. the sky was more or less obscured by broken clouds. During the evening, for the greater portion of the time, two persons were on the watch continually. The observations were made by Messrs. Simons, Brandt, McClure and myself.

"A little after 1^h A. M., ten meteors of considerable brilliancy were noted, emanating from the direction of Leo, and passing through the constellations Gemini and Canis Major. Clouds now obscured the greater portion of the eastern heavens.

"At $1^h\ 25^m$ A. M., two of great brilliancy, more than double the size of Sirius, shot almost simultaneously from under the eastern clouds, one moving toward the south and the other toward the northwest, producing phosphorescent lines along their course, and before disappearance emitting luminous trains. From this time until $3^h\ 45^m$ A. M., the clouds prevented all observations.

"At $3^h\ 50^m$ the eastern sky was nearly free from clouds. The meteors now began to appear with considerable frequency, and we made arrangements for locating their paths, by means of the comet-seeker and chart; as also to record the times of flight by magnetic registration on the Chronograph.

"We had located two or three, but during the time necessary to read the circles and make the necessary notes, 8 or 10 escaped, and as they continued to fall with increasing frequency we decided to abandon the location of paths, for unless they were recorded chronographically at other stations they could not be identified. We thought, however, to continue the record of the time of appearance and time of flight; but in a few minutes the number increased so rapidly that we found it impracticable, as it was impossible to record all. We desired, moreover, to see this magnificent display to the best advantage.

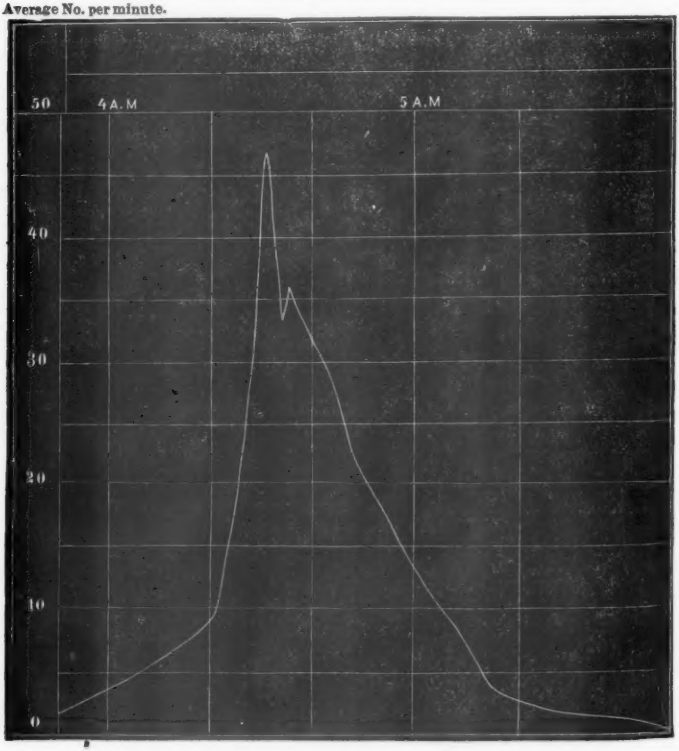
"The following notes were made at the time:

"$4^h\ 16^m$ A. M.—They fall with increased frequency, and are of greater brilliancy. Four brighter than second-magnitude stars shot in quick succession to the northwestern horizon. They are radiating from Leo in all directions. $4^h\ 18^m$.—One brighter than Jupiter, of a beautiful and purple color, shot toward the southwest near the full moon. It left a train visible for fifty

seconds. $4^h\ 33^m$.—Partially clouded over. $4^h\ 41^m$.—Clear sky. $4^h\ 48^m$.—One larger than any previously seen, shot from Leo toward the eastern horizon.

"$5^h\ 01^m$.—Two of dazzling brilliancy emanated simultaneously from the same point, and passed through Ursa Major, disappearing at the northern horizon. The trains remained visible nearly a minute. $5^h\ 07^m$.—A very brilliant one passed from Leo northeast, its path being very near Arcturus. It left a train visible sixty-five seconds. $5^h\ 08^m$.—Clear in the zenith and east, but cloudy in the west. Many meteors pass through Ursa Major. $5^h\ 20^m$.—Cloudy. $5^h\ 38^m$.—Clear in the east. $5^h\ 41^m$.—A very brilliant one moved toward the north, leaving a broad train, which remained visible sixty-seven seconds.

Diagram showing the average number of Meteors per minute, observed at the Dudley Observatory, Albany, Nov. 14th, 1867, from 3 h. 50 m. A.M., to 5 h. 50 m. A.M.



"The following table shows the number of meteors counted, all emanating from the direction of the constellation Leo.

Dudley Observatory Mean time.	No. of Meteors.	Mean time.	No. of Meteors.	Mean time.	No. of Meteors.
$4^h\ 05^m$ A. M.	37	$4^h\ 35^m$ A. M.	512	$4^h\ 53^m$ A.M.	1000
4 25 "	180	4 38 "	610	4 59 "	1100
4 30 "	312	4 41 "	708	5. 08 "	1200
4 32 "	406	4 44 "	802	5 22 "	1247
4 33 "	440	4 48 "	900	5 54 "	1301

"It appears from an examination of the foregoing table, that the maximum of frequency occurred at $4^h\ 31^m$ A. M.; and the rate of fall was forty-seven in one minute.

"The annexed diagram exhibits the progress of the shower. It shows the rate of fall from minute to minute from $3^h\ 50^m$ to $5^h\ 50^m$ A. M., as deduced from the preceding observations. When the shower was near its maximum, six or eight meteors would frequently shoot out simultaneously, and generally they appeared to fall in groups of two or more at a time. One of the most noticeable features, however, was the permanence of the train after the meteor had disappeared. In a number of instances it remained visible more than one minute by actual determination with a chronometer."

16. *In California.*—A writer in the San Francisco Times states that nearly 500 meteors were counted in half an hour between one and two o'clock, on the morning of Nov. 14th. A correspondent of the Sacramento Union, states that from fifteen minutes before two o'clock, they gradually decreased in numbers until he retired, at five o'clock, when an occasional one could be observed. Dr. Harkness states that when he was first notified of their appearance at 20 minutes past one o'clock, they were falling at the rate of about fifty per minute.

17. *At Chihuahua, Mexico.*—Mr. George L. MacManus of Chihuahua writing to Mr. B. V. Marsh says, "when we first observed the meteors we attempted to count them. We counted three hundred and eighty in about ten minutes but then they fell so thick and fast that we gave up in despair. . . . . Often twenty or thirty at a time were seen."

18. *In Europe.*—There appear to have been no unusual numbers of meteors seen in Europe on the morning of Nov. 14th.

19. *Geographical limits of the shower.* — For the reasons mentioned in the Jan. No. of this Journal, last year, (vol. xliii, p. 88), the eastern limit of the regions on the earth's surface in which the shower was visible must have been a line running S. 18° W. through the center of the N. Atlantic ocean, and through South America a little east of its center, The western limit was a line in the Pacific ocean running N. 24° W. a

little east of the Sandwich Islands. Just beyond these limits a small display may have been visible. In the Sandwich Islands any meteors that may have been seen would have the peculiar characteristics of those seen in the Azores last year.

20. *Personal equation.*—An examination of the numbers reported in the New Haven observations shows that there is a very notable difference in the numbers seen by different persons at the same place, during a given interval. This is due, in part at least, to the unequal attentiveness and quickness of eye of the observers, and to the direction toward which they are looking. The person of a company who sees the largest number of meteors during one minute is, moreover, not always he who sees the largest number another minute.

Hence we cannot rely implicitly upon the counting of one person to determine the minor variations of density of the stream of meteoroids, as we pass through it. Again, the numbers seen at different places by single observers cannot be compared with the same confidence as the numbers seen by two parties of considerable size. Individual peculiarities may reasonably be expected to disappear to a certain extent in the latter case.

21. *Form of the curve of intensity.*—The three curves given in the diagrams above, as well as all the other observations of 1867 and 1866, show that the diminution of the intensity of the display was less rapid than the increase. This is due, evidently, to the gradual increase in the apparent altitude of the radiant toward morning. A tolerable correction might be made for this cause by dividing the numbers expressing the intensity of the display by the sine of the altitude of the radiant.

22. *Breadth of the radiant in Latitude.*—That the radiant should not have breadth in latitude seems necessarily to follow from the very small thickness of the stream. In one hour the earth moves about 20,000 miles in a direction perpendicular to the plane of the meteor group. The duration of the shower is limited to a few hours at the utmost, and in its greatest intensity to one or two hours. But if the radiant has a breadth in latitude of only a single degree, it would seem to follow that the group is more than a million of miles in thickness, which would give us a shower lasting for days.

23. *Length of the radiant in longitude, and distribution in longitude of the perihelia of the orbits of the meteors.*—That the radiant has length implies that the perihelia of the orbits are distributed considerably in the plane of the stream. If the radiant is 5° long the direction of the relative motions of the meteors from the two ends of the radiant differ 5°. The

directions of their absolute motions would differ still more, in fact more than 8°. This difference, moreover, implies a distribution of the perihelia of the orbits of the individual meteoroids along an extent of about 17° in the plane of the group.

It hence follows that when the group is at *aphelion* it will be scattered over an arc of similar extent on a circle whose radius is the aphelion distance. Seventeen degrees on such a circle would be nearly nine times the distance from the earth to the sun.

24. *Comet of* 1366.—It was suggested in the May No. of this Journal (xliii, p. 298) that the Comets of 1866 and 1366 might prove to be identical. I had not then access to E. Biot's translation of the Chinese accounts. The following is an English translation from Biot (Additions to *Connaissance des Temps*, 1846, p. 49).

"..... 1366, Oct. 25th, (period *Tchi-tching*, 26th year 9th month, day *Keng-tseu*) a comet was seen near the star δ Ursae Majoris, within the circle of perpetual apparition. Its color was like that of a handful of flour; it was nearly as large as a bushel measure. It went southeast, and passed near the group β, γ, Draconis. The day *Sin-tcheou* (Oct. 26th) it was at the $18\frac{50}{100}$ degree of the stellar division *Ouei* (determinant star μ^2 Scorpionis). The day *Fin-yn* (Oct. 27) it was at the $2\frac{50}{100}$ degree of *Niu* (determ. ε Aquarii). The day *Kouei-mao* (Oct. 28) it was at the $9\frac{90}{100}$ degree of *Niu*. The day *Kia-tchin* (Oct. 29) it was at the $0\frac{80}{100}$ degree of the division *Hin* (determ. β Aquarii). The day *Y-sse* (Oct. 30) it went from the enclosure of *Tse-wei* between the stars δ Ursæ Majoris and ε Ursæ Majoris. It was in the division *Tchin* (determ. γ Corvi): it went to the southeast and passed near the group β, γ, Draconis; it crossed the groups β, δ, Lyræ and η, θ, Lyræ; removed from the stellar division *Hiu* (determ. β Aquarii); passed near the western star of *Loui-pi-tchin* (small stars in Aquarius and β Piscium); and began to disappear."

It is evident that unless the writer has repeated his story, two comets are here spoken of. The following explanation of the account is suggested. One comet passed from δ Urs. Maj. rapidly across the heavens through Draco and Lyra into Aquarius, where it was seen on the 29th of October. The next night it was not found there, but another comet was discovered in Ursa Major and was assumed to be identical with the first. The second comet traversed very nearly the same route as the first in a period not given.

Both described paths which may be called with entire propriety *conformable*, being from a radiant several degrees west of Leo. This radiant would have a longitude of about 135°, and would be four or five degrees from the longitude of what has been styled the *apex of the earth's motion*, i. e., the point

to which the earth was then moving. The earth passed the node of the group on the morning of either the 22d or the 23d of October, and one of the most remarkable of star showers was witnessed in Europe between the hours of matins and primes.* The two comets traversed in the sky a course along which the meteor group would, if visible, have been seen projected.†

If this explanation of the Chinese account be the true one, we cannot say that either of these two comets is the same as Comet I. 1866. We are led to the conclusion that the group contains two, and probably several comets of respectable size.

Accounts from Prof. Leonard, of the Iowa State University, and from Prof. Young of Dartmouth College, and also the report from the U. S. Naval Observatory at Washington, have reached us too late for this article. Numerous observations for parallax made at Washington, Germantown, Haverford, the Palisades, Poughkeepsie, Stamford, New Haven, Williamstown, Hanover, and Cambridge, need comparison and reduction before they can be of use. We hope to resume the subject in a future number. H. A. N.

ART. XVI.—*Notice of a peculiar mode of the occurrence of Gold and Silver in the Foot-Hills of the Sierra Nevada, and especially at Whisky Hill, in Placer county, and Quail Hill, in Calaveras county, California;* by B. SILLIMAN.‡

IN the search for ores of copper which occurred in California in what is now known as the "Copper Belt" of the Lower Sierras, deposits of "Iron Rust," as they were called by the miners, were observed at numerous points far below the range of the main gold belt of the Sierras. Several of these ochraceous deposits had been previously "located" by prospecting miners for gold, before there was any knowledge, or suspicion even, of the existence of ores of copper in connection with them. It was a matter of common observation that certain gulches, or watercourses in the neighborhood of these rusty deposits, were rich in placer gold, having been worked for gold from an early date. The search for copper in this kind of deposit was not commercially successful, although there were shipments of green and blue carbonates of copper, red oxyd and metallic copper, to a limited extent from both the localities here referred to, the metal from which was known to contain a notable value of gold and silver, stated to be about fifty dollars to the

* This Journal, xxxvii, 383.

† The comet of 1366 is described by Pingré, but owing to an error of the month the date is carried forward the cycle of 60 days into August.

‡ Proceedings California Academy, April 15, 1867.

ton of ore. This search for copper has, however, opened up these deposits so as to display their character in a conspicuous manner.

The rocks appear to have been originally talcose and chloritic schists, sometimes micaceous, enclosing masses of argillite, and of quartz which appears to have been massive enough at certain points to assume the character of a vein, and parallel to the stratification which has the usual northwestern strike and easterly dip of the region. All this mass of material, which at Quail Hill is certainly three hundred feet wide, and possibly twice that, and with a linear extent exceeding one thousand feet, appears to have been very highly impregnated or mineralized by sulphurets, chiefly of iron, with a portion of copper, zinc and lead. The sulphurets have undergone almost total decomposition throughout the entire mass, leaving soft ochraceous deposits of a rusty red and yellow tint, and staining the rocks with brilliant colors, a peculiarity which the miners have characterized by the name of "Calico rocks." This decomposition or oxydation of the sulphurets has extended as far as atmospheric influence penetrates, or probably to a point where water is permanently found, which at Quail Hill is assumed to be about 170 feet below the outcrop of the mass or crest of the hill. Dykes of porphyry and of other rocks, commonly called intrusive, are seen dividing these great ore channels in a direction conformable to the line of strike. But the decomposition which has affected other portions of the ore channel appears also to have changed them, for they are found to be reduced completely to the condition of kaolin and lithomarge, or kindred alterations of feldspathic rocks. The outlines of the feldspar crystals are still easily distinguished, although the mass of the dykes is completely friable. The zinc blende which is found in small quantities at Whiskey Hill, and the vitreous copper also to some extent, appear to have escaped decomposition. The copper ores seem to have been confined to a portion of the deposit, as is indicated in the section exhibited, while the auriferous sulphuret of iron has been co-extensive with the ore channel, the cubical cavities left by the decay of its crystals being found in all the outcrops both in the quartz and in the 'calico rocks' resulting from the decomposition of feldspathic and talcose or chloritic constituents.

Accompanying the entire mass of decomposition at both localities occur both gold and silver, disseminated with remarkable uniformity in all parts of the ore-bearing ground. At Whiskey Hill, films of metallic silver are visible upon the talcose masses stained green by malachite or chrysocolla; the

gold is rarely seen in situ, being mostly obscured by the very rusty and highly-stained character of the associated materials. But it is rare that, on washing a small quantity of any of the contents of these great deposits, gold is not found in angular grains or small ragged masses, from the size of a few grains' weight, to impalpable dust. Nuggets of several pennyweights occur occasionally. This gold has evidently accompanied the sulphurets and been left in its present position and condition by their decomposition. There can be little doubt that the gold of the gulches adjoining these deposits has been derived from them. At Whiskey Hill, the gulch gold ceases to be found as soon as the limits of this deposit are passed, and the same is true at Quail Hill. The occurrence of deposits of this nature throughout the range of the foot-hills seems to offer the best solution which has suggested itself of the origin of the placer gold which is found in situations so far removed from the gold belt of the upper Sierras, and away from sources usually recognized as those to which placer gold may be referred.

Experiments made by myself and by others on a considerable scale, the details of which will appear elsewhere, show that the amount of the precious metals disseminated in the average mass of vein stuff and decomposed materials of every name at Quail Hill, is considerably in excess of the general average tenor of gold veins in California. The mean of my own trials gave to the ton of 2,000 lbs. by assay:

Gold	$35.14
Silver	15.08
	$50.22

While from the working of carefully prepared averages in considerable quantity by milling process, the tenor of the precious metals was:

Gold	$29.18
Silver	5.91
	$35.09

The extreme friable condition of the entire yield of these auriferous materials renders their extraction and treatment easy and comparatively inexpensive.

At Whisky Hill, a mill of forty stamps has been set up which is now running with satisfactory returns—the cost by contract of delivery of the ores to the mill being stated at forty cents per ton, the cost of mining and treatment in mill being considerably less, it is said, than one dollar per ton, the amount treated being five tons to each stamp.

The chemical results of the extensive decomposition of metallic sulphids which has in former times occurred at these localities, offer an interesting problem in chemical geology. The sulphur has been removed chiefly beyond doubt as sulphuric acid, which has combined with iron and copper to form sulphates of these metals. These have for the most part disappeared, being washed out by the atmospheric waters, and have followed the drainage of the country. At Whisky Hill I found the sulphate of iron, (Coquimbite) sulphate of copper, (Cyanosite) and alum. The water of the shaft contains copper enough to redden the iron tools. At Quail Hill considerable masses of heavy spar are found, formed probably from the action of soluble sulphates upon witherite. No gypsum was observed at either locality.

The mineral species found at Whisky Hill, are as follows:

Metallic Gold.
Metallic Copper.
Metallic Silver.
Red Copper.
Malachite (green carbonate of copper).
Azurite (blue carbonate of copper).
Chrysocolla (silicate of copper).
Cyanosite (blue vitriol).
Copper Glance (Vitreous copper).
Zinc blende.
Galena.
Iron pyrites.
Alum.
Coquimbite.
Heavy Spar.
Hematite (chiefly the earthy varieties).
Kaolin.
Lithomarge and various aluminous and magnesian silicates resulting from the decomposition of the chloritic and talcose rocks.

The list of species is about the same for the deposit at Quail Hill.

The line of division between the ore-bearing ground in these great ore channels, and the country rock is quite distinctly seen on both eastern and western outcrop at Quail Hill, and on the western at Whiskey Hill. At the former place it is a dark bluish porphyritic rock, probably metamorphic of a sandstone or siliceous sediment. The outcroppings resemble those of many quartz veins, and I find the moss-covered portion of this quartzose matter full of cavities, resulting from the decay of pyrites, and yielding, by assay, three to five dollars to the ton in bullion.

From all the evidence presented, we seem justified in regarding these remarkable metallic deposits as segregated veins, holding a pretty uniform and large percentage of gold and silver, associated with and derived from the decomposition of extended masses of metallic sulphurets and quartzose matter, and carrying, at times, ores of copper, the commercial value of which is, however, entirely subordinate to that of the precious metals which are found to characterize these veins or ore channels.

San Francisco, April 15th, 1867.

ART. XVII.—*Observations on Skylight Polarization in Nebraska;* by EDWARD A. CHASE.

THE observations with the Savart Polariscope, of which a partial report was published in the September number of this Journal, were continued through the summer and a portion of the autumn.

On account of the interruption caused by rain, clouds, and the camp duties of the Geological Survey, I was unable to accomplish so much as I desired; but the low, unbroken horizon of the prairies appeared peculiarly favorable for observations upon the neutral points, and the following brief summary, may, perhaps, be worthy of record.

No. of days on which obs. were made,	44
" of observations,	62
Observations of Arago's neutral point,	44
" " Babinet's " "	59
" " Brewster's " "	19

Simultaneous Observations.

Arago's and Babinet's n. ps.	36
Arago's and Brewster's "	1
Babinet's and Brewster's "	17
Arago's, Babinet's and Brewster's,	6

When Babinet's and Brewster's neutral points were both visible,

Brewster's appeared most distinct,	6
Babinet's " " "	5
Both were equally distinct,	6

Thirteen of the observations were made when Brewster's neutral point was below the horizon.

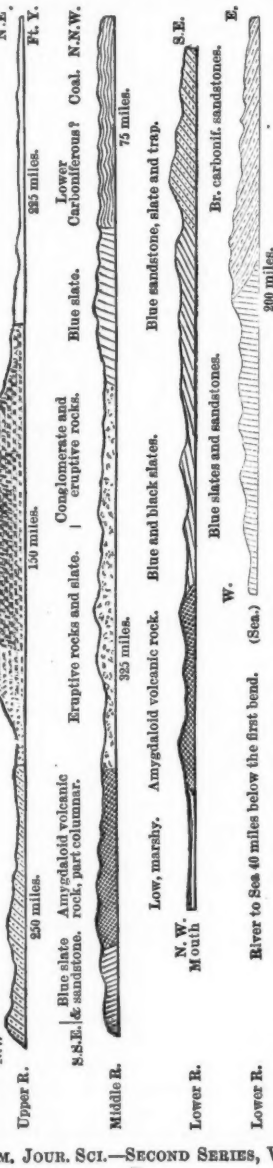
I.—*Editorial Correspondence.*

Explorations in Russian America; by W. H. DALL, (from a letter addressed to J. D. DANA, dated Russian Extension, St. Michaels, R. Am., Aug. 13, 1867).

Some account of last season's work in this country may not be devoid of interest to you. Since last September I have crossed Russian America in its widest part from the sea nearly to the British boundary line, and have carefully examined the geological formations of the country.

The Youkon river, the great central artery of this portion of the territory, enters Alaska about midway between the Polar Sea

and Mount St. Elias. From this point about fifty miles it is joined by the Porcupine river, and I have traversed its entire course, thence some 1300 miles to the sea south of Norton Sound; being the first trip ever made from Fort Youkon (H. B. Co.) to the mouth of the river. It describes a kind of gigantic "S" through the territory in question; from the Porcupine river at the upper end of the "S" to the first bend at Koyoukuk in a southwesterly direction 630 miles; meeting about 375 miles from Fort Youkon, the Tananá river from the southeast, and at the bend the Koyoukuk river from the north; from this point to the second bend in a south (slightly easterly) direction 450 miles, meeting the Takitesky river from the northeast, and the Anoik river from the northwest; from the great bend to the sea, in a northwest direction, about 250 miles, terminating in a tremendous delta, nearly as large as that of the Ganges. I have obtained specimens of rock and fossils sufficient to prove the ages of the strata, but a very few words will serve for a general description.



The annexed diagrams, though having no pretensions to accuracy in detail, will give you some idea of the rocks.

Starting from Fort Youkon and going down stream, we have on either hand, low land sparsely wooded with spruce, poplar, birch and willow, with low hills in the distance, gradually increasing in height and coming closer to the river, where they finally come together 225 miles below Fort Youkon; and the river which previously has been very winding, full of sloughs and large islands, and from three to nine miles wide, here becomes narrow, deep, and rapid, with one channel. These

mountains are known as the Ramparts, and come close to the water's edge, having an imposing appearance, though probably not more than 1500 to 2500 feet high. They were entirely composed of Azoic rocks, of which a silvery greenish rock of talcose *appearance*, but very hard, predominates. Quartz, in seams, slates and quartzite rock are abundant; and a rock resembling granite, but with a superfluity of feldspar, and no mica, rarely. The slates generally have a northwesterly dip.

True granite appears only once, near the termination of the Ramparts, and forms a ledge extending across the river and making a rapid; not, however, a dangerous one. Fifty miles or less, below the rapid, the Ramparts terminate, the Tananá river (or river of mountains) comes in and from this point to the mouth, as a rule the river is wide, with the right bank high and the left bank low, but occasionally with mountains in the distance or a bluff on the river. From the end of the Ramparts to Koyoukuk river (250 miles) the right bank presents in their order: conglomerate, quartzite, bluffs of yellow gravel, blue talcose slate, conglomerate, hard blue slates and quartzose rocks, blue sandstones and a soft green rock (Plutonic) with light stellate spots in it. Granite is very rare and mica also. I have found fine specimens of obsidian on the beach and just above the Ramparts, pebbles of Niagara limestone with its characteristic fossils. From the bend we find the following strata: blue sandstone, (unfossiliferous) brown sandstone in beds at least 500 feet thick, containing vegetable remains, in some layers and rarely, casts of mollusca, all as far as I have collected, Lamellibranchs. Thirty miles below the bend, is a small contorted seam of coal between two thin layers of shale containing very poor vegetable remains, and underlaid by the brown sandstone which also overlies the blue sandstone; which in its turn I think covers the blue slates. The coal seam is very limited, being on the extreme point of a bluff and the greater part of it has been denuded. The fossils are very poor, vegetable, and resemble Fuci. The coal is of good quality, bituminous, non-caking, and leaves a gray ash. The seam is 16 in. wide.

The sandstones continue down the river some 45 miles, more generally with a N.W. dip, and always in gentle undulation, sometimes continuous for miles, and often broken short off. Below, the rocks for 300 miles, are slates and eruptive rocks of a pink color, sometimes containing spathose minerals. The formation changes, at the Russian mission, from hard blue slate, to a volcanic rock, full of almond shaped cavities which are empty; but certain parts of the rock are quite solid. It is black and contains minute crystals (of ? olivine.) [It is roughly columnar on Stuart's island, Norton Sound, in five sided columns, on the beach.] From this to the sea, the banks are mostly low, but when they approach the river they are invariably blue hard slaty sandstone or sandy slate: the rock passing from one into the other imperceptibly. This formation extends to St. Michaels, nearly where the fore-mentioned volcanic rock takes its place, and continues up the shore of Norton

Sound some 30 miles, when it it is replaced by the hard slates and sandstone, and I have followed them up for 30 miles more to Unalákleet river. Here you cross in winter to the Youkon, 200 miles of portage.

The entire country is sprinkled over with remains of Pliocene animals, ? *Elephas*, *Ovibos moschatus*, &c. Beds of marl exist near Fort Youkon, consisting of shells (fresh water) still found living in the vicinity. The Kottó river, emptying into the Youkon above Fort Youkon, is held in superstitious dread by the Indians on account of the immense number of fossil bones existing there. The Inglutálic river emptying into Norton Sound, has a somewhat similar reputation.

The collections this year are not so large as if I had had some one else in the country to assist me, but they are more than made up by the great success of Mr. Bischoff at Sitka. My own collections amount to some 4,550 specimens, filling eight cases.

I have journeyed with the thermometer from 8° to 40° below zero, with dogs and sleds, and in the summer with it up to 110° have paddled 15 hours a day. I have travelled over 2,500 miles since last September, mostly in canoes or on snowshoes.

I have carefully examined the country over which I have passed, for glacial indications, and have not found any effects attributable to such agencies.

My own opinion from what I have seen of the West coast, though yet unproved, is that the glacier field never extended in these regions to the westward of the Rocky mountains, although small single glaciers have and still do exist between spurs of the mountains which approach the coast. No boulders, such as are common in New England, no scratches or other marks of ice action have been observed by any of our party, though carefully looked for. I shall examine the crests of the accessible mountains for traces, this fall, if possible. Notwithstanding the cessation of operations by the Telegraph Co., I intend, if I can obtain the necessary permission, and trading goods to buy provisions from the Indians, to remain in the country and carry on the work as long as my funds will allow. I shall devote to this purpose the savings of my salary as assistant Surgeon for the last two years, about $600, and endeavor to fulfil my pledge of carrying out the work left almost untouched at Mr. Kennicott's death.

Note on the Physical Geography of the Andes of Quito; by James Orton. (Letter to J. D. Dana, dated Quito, Ecuador, Oct. 12, 1867.)

Knowing your interest on every fact bearing on Physical Geography, I send you a line from the Andes, preparatory to something more elaborate on my return. The first and most important problem which you suggested previous to my departure, was the slope of the volcanic cones. This interesting question I have ever kept in view in my travels up and down this valley; but

I have time to make only some general remarks. Humboldt's sketch of Catopaxi is manifestly overdrawn. And yet his mistake is very natural, for the angle of a lofty symmetrical cone like that of Cotopaxi is very deceptive. I never knew an attempt to draw by the eye a volcanic peak without the error of making it to steep. One of my party made Humboldt's mistake in pencilling Cotopaxi. Upon assuring him that he had made the angle to acute, the artist at once replied that his drawing would not look like Cotopaxi, were he to give the slope less than 40°. Farrond's distant photographic view of Cotopaxi (I have not seen his near view), is probably correct; yet it does not look like Cotopaxi. It does not give as just a view of the *appearance* of the volcano as Humboldt's. It should be borne in mind that even a photograph of a volcano may distort nature. A photographer may incline his camera upward in order to include the peak; but in so doing he will increase the angle of the slope. We cannot depend, therefore, upon a photograph, unless we are certain that the camera was perfectly horizontal. All the views of Cotopaxi I have seen are from the west, giving the north and south slopes. I have found that by means of level, that the slope of the *west* side is 35°; while the west slope of Tunguragua is 40°. The last great eruptions of these volcanoes occurred within six years of each other,—Cotopaxi throwing out ashes and pumice chiefly; Tunguragua covering its sides with the fragments of a tough, black rock having a slight conchoidal fracture; yet the angle is very nearly the same. Cotopaxi must divide the palm of beauty with Tunguragua, which is equally symmetrical, but not being so isolated is not so striking. Tunguragua has on its north side a stream of broken lava similar to those on the flank of Antisana. Cotopaxi is the great pumice-producing volcano; I observed none around Tunguragua. On Antisana alone I observed laminated obsidian. The altitude of Carguirazo is given, on whose authority I know not, as 15,673 ft. But this is a plain error. For the snow-limit in Ecuador is 15,790 ft.; yet Carguirazo is as snow-clad as Cotopaxi. My theodolite was out of order, and I could not ascertain its true height.

As to the porphyry of the Andes, it has been said that much of it is a porphyry conglomerate. My observations do not verify this statement. It is true I have met with many specimens of pseudo-porphry; but the great mass of porphyritic rock is a true porphyry, having a homogeneous base; the strongest glass I can command does not reveal any signs of conglomeration. I will say, however, with Humboldt, that the scarcity of quartz is quite remarkable. I have noticed but one earthquake and that seemed to fulfill the law—passing at right angles to the great axis of elevation. The great earthquake of 1797, which destroyed old Riobamba, also obeyed the law, leaving its track from Tunguragua through Pelites and Guano to old Riobamba. There is, however, just south of Tunguragua, a long series of undulations of the earth's surface, very uniformly 30 feet apart. If an earthquake produced them, as some think, it moved parallel to the Cordilleras.

It has been stated that the experiments of Wisse with the thermo-barometer prove the accuracy of Regnault's tables,—the differences between the barometric pressures given by Regnault and those found by Wisse never exceeding a few tenths of a millimeter. I have also been trying the same experiments with Green's standard barometer and the boiling apparatus side by side from the sea leavel up to 15,705 ft., and I find a greater conformity at low altitudes than at high elevations. Thus, the mean barometer at Guayaquil is 30·005; the boiling point, 211°·95; the mean barometer at Quito is 21·600; the boiling point, 195°·8; on the top of Pichincha, the barometer stood at 17·074 and water boiled at 184°·5.

I have been making extensive excavations in a ravine near Riobamba, and have taken out over a hundred fossil bones,—among them the femur of a Mastodon 40 inches long, and the skull of a horse. They were evidently washed down from another place, as we seldom find together any two anatomically connected, and many of the bones imbedded are broken. But these relics are interesting as showing the inhabitants of the high valley of Quito in pre-historic times.

Rocky Mountain Coal beds; by Dr. F. V. Hayden. (From a letter to J. D. Dana, dated Cheyenne City, Dakota Ty., Oct. 31st, 1867.)

My investigations during the past summer convinced me that there is no probability that any workable beds of coal will ever be found within the limits of the state of Nebraska. The future prosperity of that state appearing to be so dependent on the discovery of beds of coal within accessible distance, that I turned my attention westward to Colorado and Dakota. I first made an examination of the lignite formations across the first range of the Rocky Mountains, on the Laramie plains, and there I found an excellent quality of Lignite in beds from 5 to 11 feet thick. Rock Creek, a branch of the Medicine Bow river, forms very nearly the eastern limit of this interior basin, and it extends westward nearly to Great Salt Lake. I have estimated the area occupied by these lignite beds at 5,000 square miles. The Union Pacific railroad passes directly through them, and by next season they can be brought into the market. I found a number of impressions of deciduous leaves in this formation, among them, a *Platanus*, and a *Populus* plainly identical in species with those obtained on the Upper Missouri. I then visited the coal beds in Colorado. Passing over the Laramie range of mountains, by the overland stage route, the first coal mines opened are at South Boulder Creek. These mines are called the Marshall mines, and are probably, the most valuable in the west. By means of the dip of the strata we find here exposed the finest section I have seen. Eleven beds of lignite, from 5 to 13 feet in thickness, are revealed, making at least 30 to 50 feet of solid lignite. Dr. Torrey made an analysis of this lignite.

Water in a state of combination or its elements,	12·00
Volatile matter expelled at a red heat in the form of inflammable gases and vapors,	26·00
Fixed carbon,	59·20
Ash of a reddish color or sometimes gray,	2·80
	100·00

All the lignites of the west, are non-bituminous, but in a furnace or stove, burn with a bright red flame, give out a good degree of heat, and, for all domestic purposes, will rank next to the anthracite coals of Pennsylvania. These lignite beds occur all along the foot of the mountains, from Pole creek far south into New Mexico. I have estimated the area occupied by these lignite beds north of the Arkansas and south of Pole creek, to be 5,000 square miles. Very soon the two great railroads, U. P. R. R., and the P. R. R. E. D., will pass directly though these great coal fields, and then they will prove as important to this almost treeless west, as the coal fields of Pennsylvania are to the east. The organic remains show very clearly that all of these western lignite deposits are of Tertiary age, and in an article on the lignite deposits of the west which I hope to prepare for the March number of this Journal, I shall be able to show that the lignite beds of the Laramie Plains, as well as those of Colorado, are parts of the same great basin so largely developed on the Upper Missouri, separated only by the erosion during the elevation of the Rocky mountains, or concealed by the deposition of the White river Tertiary beds. When this great lignite basin has been thoroughly explored, it will be found to be one of the most extensive and interesting deposits on the globe. All the facts which I have obtained during this trip, only confirm the statements which I made in an article published in the Proceedings of the American Philosophical Society, last winter, that the lignites of Colorado and those in the Naton mountains are only the southern extension of those so finely shown on the Upper Missouri.

II.—*Editorial Note.*

Prof. G. Hinrichs, now of Iowa, is circulating, in connection with a resumé in French of a memoir of his, entitled Atom Mechanics, a charge of plagiarism against the writer—and plagiarism from an article communicated for this Journal and refused publication.

The crime is so abhorrent to me, and so utterly at variance with all my practice in life, as I believe my writings testify, that I am almost irresistibly impelled to use in the denial only one short word. But it bears on my editorial relations, and I therefore feel it a duty to state the facts in the case.

The paper referred to was sent to this Journal early in March, when I was too unwell even to look at it. Since December I had been compelled to suspend all head-work, and even my college duties of an hour a day, and I was but just beginning to regain my strength. I had recently resumed the preparation of the new

edition of my Mineralogy, but only through an assistant, Professor Barker, and was able barely to give the occasional advice required. The paper of Prof. Hinrichs, on its reception, was put unopened into Prof. Barker's hands for perusal and a report to me of its contents. It was the only mode of editorial reading that I was capable of giving it. In his report, which I regarded as furnishing me a good idea of the scope and character of the article, there was not the slightest allusion to the idea brought out in my paper, or any thing bearing that way. At my request, Prof. Barker, aware of my views, went over it a second time, and added to his former report the further positive statement that he found no views similar to mine in the article. It was filled with other discussions, and seemed, in the main, to consist of baseless speculations. Unwilling to act editorially on my own judgment of the article thus obtained, the paper was sent, without accompanying comment, to Dr. Gibbs of Cambridge, our associate editor; and on receiving his advice to return it to the author, it was returned. Later, another paper of the same nature came from Prof. Hinrichs, accompanied with an angry and peremptory note; it was almost immediately returned to the author after only a very partial perusal. We had already had in the Journal a specimen of Mr. Hinrichs's speculations on atoms, at page 365 of volume xlii, which, from the first reading, had seemed to me fanciful and unintelligible, and as acceptable in that place only as the thoughts of a man of unquestioned learning.

The views which I advanced in my paper occurred to me while attempting to write out the formulas of the mineral silicates on the basis of SiO^2 instead of SiO^3. This changed the formulas for the Unisilicates from $\dot{R}^6\ddot{S}i$ to $\dot{R}^2\ddot{S}i$; and for the Bisilicates from $\dot{R}^6\ddot{S}i^3$ to $\dot{R}\ddot{S}i$. It brought, literally before my eyes, the fact of the connection of Tetragonal forms with 4 of oxygen (as in Unisilicates), and not with 3 of oxygen as in Bisilicates; and the view was afterward elaborated, and published in the July number of this Journal, without a suspicion that Prof. Hinrichs had ever held, or thought of, such a kind of relation, or had made any special use of the numbers 3 and 4 in connection with atoms.

Early in August came by letter Mr. Hinrichs's first charge of plagiarism. I promptly denied it in a friendly note, for, until the return of his article, our relations had been of the most friendly kind. Knowing of no ground for the charge in the papers returned, and observing that I was suspected also of having used a copy of his Atom Mechanics (in German), sent to the College Library, (received there July 2d, some time *after* my paper was wholly printed off), I at once referred to the memoir: and, on examination, I found there, besides various speculations, embracing the wide range of physics and chemistry, some degree of coincidence in one part with my own idea, although much involved with other hypothetical views. I wrote him the next day that I should take pleasure in giving him full credit for priority (the publication of his memoir antedating that of our July number over a fortnight) in any points in which, on further examination I should find he had

anticipated me; that I should make such acknowledgment willingly, caring less who brings out new ideas, than for the ideas brought out; and in the September number, on page 263, a note is appended to my article admitting the coincidence and priority here referred to, with a promise of a review of the memoir at another time. Until August I had not seen the "Atom Mechanics."

Before the September No. of the Journal was issued, Prof. Hinrichs gave an abstract of a portion of his Atom Mechanics in the Journal of Mining published in New York City; and in the course of his concluding "historical remarks" (Sept. 7) he took occasion to make public his charge of plagiarism. The charge was followed, in the same Journal, by a brief statement of the facts by me, showing that the charge was utterly and completely without foundation.

He now reiterates the charge; and I make here my final denial. His first suspicion was perhaps natural. His reiteration, after the statements and explanations which have been made, with the further untrue statement that my former denial was not full and complete, shows a disordered state of mind and temper.

Prof. Hinrichs includes, in his last charge, my September article.

The prominent peculiarity of the paper (apart from some of its mineralogical details) is the use of Greek letters in the symbols of the different oxyds (deutoxyds and tritoxyds as well as protoxyds and sesquioxyds) reduced alike to the protoxyd type; and the writing out of the formulas by this means systematically on a unit scale. The idea of reducing the oxyds to the protoxyd type is old, as I have recognized; yet it is ordinarily restricted by chemists who adopt the view to protoxyds and sesquioxyds. The general formulas, on the new system, of the Unisilicates, Bisilicates and Subsilicates, are those of Odling, Wurtz, etc. The recognition of the grand types of Unisilicates, Bisilicates and Subsilicates is the fundamental idea in the classification of the Silicates in my Mineralogy of 1854 (last edition), and is there brought out more fully than by any previous author. Moreover, in this same volume, the view that the oxyds, from protoxyd to tritoxyd, are mutually replaceable, on the principle that replacing power equals combining power (an idea which I had deduced long before from the writings of Gerhardt and Laurent), is adopted throughout.

These important points do not appear to be embraced in the charge, but only the trivial one of placing, in the formulas, the symbol of the uniting oxygen, O, *between* the symbols of the acidic and basic elements, instead of after a bracket as is usually done, which position he regards of theoretical importance. I was not aware that Prof. Hinrichs had thus placed the O, or that there was any theoretical reason for preferring this method; and *his* reason, which I have recently learned, is based on a principle that is directly opposed to my published views. I adopted the plan simply because the formulas thus arranged took up less space on the page, and were more easily compared in a table.

Now for some facts of *another kind.* I touch on only half a dozen points out of many in the memoir of Prof. Hinrichs.

In the "Atom Mechanics" there are the following paragraphs:

§ 253. *Chrysoberyl* has its prism 119° 46′, or 14′ less than 120°; the other angle is 120° 7′, instead of 120°. The vertical axis is given a=·81 (Dana); but the form admits of $a'=\frac{3}{2}a$=1·21 quite as well. In this case, however, 1·21 is only 0·01 smaller than 1·22=$\sqrt{\frac{3}{2}}$. So that chrysoberyl must be referred to a fundamental form differing very little from the tesseral form in a rhombohedral position. With this view the formula Be Äl, also coincides; by which it is placed with the Spinel group. *Dana*, it is true, gives Be Äl, which allies it to corundum; but in the latter a=1·361, which is very different.

§ 254. We could cite very many such forms; our space however will not permit it. The two exceptions above given are sufficient to show that whoever bases a classification upon crystal-systems, builds a purely artificial edifice, which must give way before the first earnest investigation. One might quite as well classify asses according to the lengths of their caudal appendages expressed in centimeters, as minerals by their systems of crystallization. Brookite, anatase, rutile, are essentially alike; in *Dana's* system, these identically similar substances are placed in three different groups. Thus it is in innumerable cases.

Prof. Hinrichs here attributes to me, in the first place, views I do not hold, and, secondly, presents, as his own, ideas which were published by me in the last edition of my Mineralogy, and the volumes of this Journal for 1854.

On pages 196 to 205 of the Mineralogy, after general observations on Isomorphism (or homœomorphism as I there term the principle), in which I dwell on the fact that the fundamental forms of the crystals of species, as adopted by crystallographers, often are not those exhibiting the true homologies of the forms, I give a series of tables, intended to illustrate the close relations of all crystalline forms to the tesseral or isometric (monometric) system, and to present the true homologies as deduced therefrom.

In these pages I do not use the forcible and elegant comparison to asses tails; but have the idea in this form: "Homœomorphism [meaning ordinary isomorphism], as Laurent has observed, is not confined to forms of the same system alone."

I afterward show that *rutile* and *anatase*, although made to differ widely in angle in the ordinary statements of the crystalline forms by authors, are actually almost identical in fundamental form. On page 197, there is a table in which the various Tetragonal (or Dimetric) minerals are arranged in Sections, with their angles, these Sections being based on the usually accepted forms.

Tin is in section I; *rutile*, cassiterite, etc., in section II; scapolite, etc., in section III; *anatase*, etc., in section IV. I then say, on page 196, that these sections I, II, III, IV, constitute a single group; and that in this group "*the basal angle of the fundamental octahedron is near* 90°;" and this group, which includes *Anatase*, I name the *Rutile group*. This is in direct opposition to the statement of my views by Prof. Hinrichs.

Brookite (of the orthorhombic system) I do not compare directly with rutile. But I illustrate on pages 200 and 202 the near relations of its prismatic form to the *tesseral* system. I have not regarded divergences, like that of brookite, as so little important as Prof. Hinrichs does; and I do not yet see reason to change my opinion on the subject.

With regard to *Chrysoberyl*, I point out similar relations to the tesseral or isometric system. A table on page 201 contains orthorhombic species in which the vertical prism is near 120°. In this table, and the same section of it, occur *chrysoberyl*, *aragonite*, *discrasite*, and a number of other species. In the remarks which follow on the tesseral relations of the forms, I observe that in this section, *the brachydome is near* 109° 28′, *the angle of the octahedron*. Moreover, in order to bring out this relation, I have taken $\frac{3}{2}a = a$; and the symbols $\frac{3}{2}\breve{1}$ and $\frac{3}{2}\bar{1}$ stand before the values of the angles of the domes of chrysoberyl in the table. The query naturally arises whether Prof. Hinrichs had not seen $\frac{3}{2}$ in Dana's Mineralogy, and the *tesseral* relation explained to his hand.

Prof. Hinrichs is wrong in making the formula of chrysoberyl (glucina being a protoxyd) $\dot{B}e\,\dot{A}l$, or that of the Spinel group. It is $\dot{B}e^3\dot{A}l$.

In § 252 of the "Atom Mechanics," Prof. Hinrichs has the following sentence:

Discrasite or *antimonial silver*, has according to Dana, the vertical prism 119° 59′; deviating therefore only about 1 *minute* from the hexagonal. And this, notwithstanding the admission of many degrees of variation in the hexagonal system (in relation to the vertical axis) without destroying the isomorphism! A deviation in another direction, however, even so slight as this, is followed by complete exclusion!

The point here is this: that I refer discrasite to the orthorhombic rather than *hexagonal* system, when there is a deviation of only 1′ from 120°. I have done this because the form *is* orthorhombic, not only in its angle, but also in the whole symmetry of the crystals. It is geometrically orthorhombic, as distinctly so as any other orthorhombic species. The question of relation to the hexagonal system is not one to be considered in such a reference. Further, not only has "Dana" done this, but so have all other authors who have written on the subject, whatever their views as to any isomorphous relations with the hexagonal system.

Prof. Hinrichs refers for the angles of species constantly, and almost exclusively, to my work (edition of 1854), and in this he gives me boundless credit undeserved, and is quite unfair to the various authors who are the real sources of the information. But when he proceeds to criticize the facts, or the mode of presenting them, or to show triumph over his better figures and methods, there is some unfairness to "Dana." It is not altogether pleasant to have to bear alone what might properly be administered equally to such men as MOHS, HAIDINGER, NAUMANN, ROSE, VON KOBELL, HAUSMANN, BREITHAUPT, BROOKE, PHILLIPS, MILLER, DESCLOIZEAUX, and many others.

Prof. Hinrichs says in § 251:

Finally, it is remarkable how almost entirely the RCl and RO R^2O^3 species belong to the tesseral system; in spite of the fact that *Dana's* antiquated formulas represent the first of these, $PbCl_2$, as PbCl.

If we examine the hexagonal forms more closely in relation to their axes we find

Axis	·7	·8	·9	1·0	1·1	1·2	1·3	1·4	1·5	1·6	1·7
No. of species,	5	12	0	0	4	0	7	1	1	1	

so that the 31 species (*all* the hexagonal minerals, except the silicates and hydrates) represented are very unequally distributed. They form three groups; that *of Apatite*, *of Calcite*, and *of the Elements*.

And in § 329:

"The normal form of the deltoid (in the Calcite group) is a rhombohedron of 104° 29′, or an octahedron with the axes $x:y:z = \sqrt{3}:1:\sqrt{3}$."

The sentence about "antiquated formulas" is a fair exhibition of the spirit of the writer. I pass it without remark, except to say that the formula which he substitutes is, in chemistry, *of later origin than my book*.

In the Mineralogy, on page 198, I have the Hexagonal species arranged, with their angles, in a table. The table is divided into Sections like the others, according to the ordinary statements of these angles. One section of it, the fifth, is *that of Calcite*, another, the fourth, is *that of the Elements;* and in one of the other three occurs *Apatite*. Of these three, I state that the third is related to the *fourth*, the rhombohedral angle being equally near 90° and but a little above instead of below 90°; and that the second, which contains *apatite*, differs from the first only by the simple ratio of $1:\frac{2}{3}$, adding that "the second becomes united to the first if we take the plane $\frac{2}{3}$ as 1."

I further state that "*the basal angle of pyramid* 1 *in the Calcite section is near* 90°; *and hence R : R in Calcite, etc., is near* 105°,"

making this tesseral feature the direct origin of the angle 105°, as done by Prof. Hinrichs. Calculating from the angle 90°, we obtain the angle 104° 29′, which he introduces into his statement of the fact.

I might go on with cases of the kind, but the above are sufficient. It is already plain that Prof. Hinrichs had studied Dana's Mineralogy before writing his Atom Mechanics, and to some advantage. His abundant references to it all show that he used the work much, and gathered ideas as well as the values of angles. This is in accord, moreover, with his acknowledgments, in the course of our former correspondence, of his great interest in my views on crystals. His "discovery" (I should call it *invention*) of "pantogen," took place, as he states, in 1855; and as its subsequent development was slow, according to his own statement, its ideas may have been largely of much later date; while the Mineralogy and the volumes of this Journal referred to, were published a year before the inception, in 1854. Prof. Hinrichs is welcome to what he has taken, and I wish him all the joy over it which he has hitherto manifested. I should not have brought up these matters, had it not been made a necessity by his charge. I believe him of honest intentions, which is more than he is now willing to say of me; and but for the *return* of his paper, the "Atom Mechanics" would have been written, I cannot doubt, in a better spirit. I sincerely hope that he may soon emerge from his cloud of suspicion, and again take a hand that is still disposed to be friendly. JAMES D. DANA.

Statement of Professor Barker.

During the spring of 1867, I assisted Professor Dana in preparing the manuscript of the new edition of his Mineralogy for the press. His health at that time was such as to forbid any mental work, save that required to direct my labors. When Mr. Hinrichs's manuscript came to the Journal of Science, it was, consequently, placed in my hands for examination. I read it carefully and returned it to Prof. Dana, stating that in my opinion, the views it contained were purely speculative; that the assumptions made in it were not proved, and were not in accordance with facts.

A short time afterward, Professor Dana explained to me his views on the connection between the number of atoms of oxygen in a compound, and its crystalline form; and also his idea that the polarity might be produced by an accumulation of the negative atoms at one end of the molecule, and the positive at the opposite.

These views struck me at the time as entirely new; and I am confident that they originated solely with Prof. Dana. He did not read Mr. H.'s manuscript personally, and knew nothing of its contents except what I had told him. As therefore I had assured him that these views were not contained in Mr. H.'s paper, even after a re-examination of it, Prof. Dana could not do otherwise than publish them as original.

A month after the "Atom Mechanics" reached the college library, when for the first time I saw this memoir, I found that the

numbers 3 and 4, occupied a prominent place in the classification of the elements, the metalloids, being trigonoids, and the metals, tetragonoids. Moreover, the crystalline form of a salt, as AB_nC was made to depend upon a plane equator, having n sides, and AC as a vertical axis. There is here an apparent approximation to the views of Prof. Dana. But neither these views nor any resembling them, do I remember to have seen in the original manuscript. If stated there, they were so covered up by fanciful analogies as not to be prominent, and hence made no impression upon my mind. If they be regarded as establishing a real coincidence, Prof. Dana still is not chargeable with plagiarism; the coincidence is rightly ascribed to "independent action in independent minds." And in whatever of truth there is common to both authors, Prof. Dana has already acknowledged Mr. H.'s priority of publication.

GEORGE F. BARKER.

SCIENTIFIC INTELLIGENCE.

I. CHEMISTRY AND PHYSICS.

1. *Note by J. D. Dana.*—In the last volume of this Journal, pages 401–406, I have pointed out a relation in anhydrous silicates between the proportion of alkalies or perissads among the protoxyd bases, and the amount of silica. The following table contains the examples thus far observed with the oxygen ratio for the bases and silica in each, and in the last column the oxygen ratio of the non-alkaline to the alkaline protoxyd bases, that is, of the Ċa, Ṁg, Ḃa, Ḟe, etc., to the Ṅa, L̇i, K̇, etc. The species *of the same group* are to be compared with one another, and not those of different groups.

		Bases	Silica	Non-alk. Alk.
CHRYSOLITE GROUP.—	Chrysolite, etc.	1	1	all non-alk.
	Leucophanite	1	$1\frac{1}{2}$	$4\frac{1}{2}$: 1
PHENACITE GROUP.—	Phenacite, etc.	1	1	all non-alk.
	Meliphanite	1	$1\frac{1}{2}$	6 : 1
EPIDOTE GROUP.—	Epidote	1	1	all non-alk.
	Zoisite	1	1	all non-alk.
	Saussurite	1	$1\frac{1}{6}$	6 : 1
	Jadeite	1	2	1 : 2
MICA GROUP.—	Astrophyllite	1	1	6 : 1
	Phlogopite	1	1	3 : 1
	Biotite	1	1	3 : 1
	Lepidomelane	1	1	2—1 : 1
	Muscovite	1	$1\frac{1}{2}$	1 : 2—6
	Lepidolite	1	$1\frac{1}{3}$	1 : 3—12
	Cryophyllite	1	2	1 : $2\frac{1}{3}$
SCAPOLITE GROUP.—	Sarcolite	1	1	9 : 1
	Meionite	1	1	10 : 1
	Paranthite	1	1	all non-alk.
	Wernerite	1	$1\frac{1}{3}$	4 : 1
	Ekebergite	1	$1\frac{1}{2}$	$2\frac{1}{4}$: 1
	Mizzonite	1	$1\frac{2}{3}$	

		Bases	Silica	Non-alk.	Alk.
	Dipyre	1	2	1	1
	Marialite	1	$2\frac{1}{6}$	1	2
Leucite Group.—	Sodalite	1	1	all *soda*	
	Leucite	1	2	all *potash.*	
Feldspar Group.—	Anorthite	1	1	all non-alk.	
	Labradorite	1	$1\frac{1}{2}$	2	1
	Hyalophane	1	2	$1\frac{1}{2}$	1
	Andesine	1	2	1	1
	Oligocase	1	$2\frac{1}{2}$	1	2
	Albite	1	3	all alk.	
	Orthoclase	1	3	all alk.	

The minerals *Jadeite* (of Damour) and *Saussurite*, of the Epidote group, are here added to those before alluded to. Jadeite has the oxygen ratio for $\dot{R}$ (principally $\dot{N}a$), $\dot{A}l$, $\dot{S}i = 1 : 2 : 6$, and the high specific gravity of 3·33 to 3·35. Dr. T. S. Hunt, in a paper treating of the identity of Saussurite and Zoisite, observes that jadeite has the ratio of dipyre with the sp. gr. of zoisite; and he concludes that it belongs to the Epidote group, and has the same relation to zoisite as dipyre to meionite.

It is here shown that this relation extends also to the *alkalinity* of the species. Moreover it appears probable that Saussurite is intermediate between zoisite and jadeite, like wernerite between meionite and dipyre.

The proportion of alkalies in Cryophyllite is wrongly stated on page 402. Prof. Cooke, in his analysis found almost three-fourths of the iron to be protoxyd; and the ratio of alkaline bases to other protoxyds is therefore 2·18 : 1. It is accordingly an exception to the views advanced, as the proportion of alkalies is less than in lepidolite, though not less than in muscovite. It is to be here noted that cryophyllite is known from only one locality, where it occurs with *altered* zircon. It is possible that like the zircon, it has undergone some alteration, although not showing external evidence of it.

In the formula of topaz, on page 258, of last volume, the ratio of oxygen to fluorine should be 4 : 1 (or $\frac{4}{5} : \frac{1}{5}$).

2. *On the Source of Muscular Force;* by John Douglas, East-India Government Telegraph Department.—The attempts hitherto made to settle the question of the source or sources of muscular energy have consisted in calculating the quantity of muscle, the component nitrogen of which would equal either the nitrogen ingested or excreted during the performance of certain measured external work.

The consideration of the ingesta appears to promise the most reliable results if the nitrogen be reduced in quantity until just sufficient to support the body in health. In considering ingesta, it may be known for certain that all the effective nitrogen is included in the calculation; in considering excreta there is no such certainty. The data furnished by ingesta may be collected over a longer time than those furnished by excreta, the latter being obtained only by continued expenditure of time and labor on the part of the observer and subject or subjects under observation;

and that generality so desirable in physiological inquiries is almost, if not quite, unattainable in the consideration of excreta, whereas, as shown below, it is easily attainable in considering ingesta.

The only source of the nitrogen of the muscles is the food, it being generally admitted that none is absorbed under ordinary circumstances by the lungs and skin. Observers agree on this point, although difference of opinion exists as to its evolution by those organs.

It appeared to me possible that the natives of India might furnish a class of persons who habitually ingest the required minimum of nitrogenous food, and that the quantity of muscle formed under the most favorable suppositions from this might be insufficient to supply by its disintegration the internal work alone; the difficulties of time, generality, absolute determination of excreta, a determination of external work might in such a case be eliminated. After some inquiry amongst the native population, I thought it possible that the jail dietary-scales might furnish the data required, and with many advantages which could not be hoped for from inquiry amongst the free population. Through the kindness of Dr. Wilson, in medical charge of the Madras Penitentiary, I was supplied with the dietary-scales in use in that prison, and from this paper I shall select only two instances.

The items composing these diet-scales may be divided into two classes—(1) articles the same quantities of which are served out daily, and (2) articles which are varied in quantity on different days in the week. In the Table given below, of articles belonging to the first class the actual daily quantities, of those belonging to the second the average daily quantities, calculated for one week, are given:—

Table of Nitrogenous Food served out to classes of Prisoners in the Madras Penitentiary.

Articles.	Proportion of proteine compounds.	Brahmins.		Malays and Chinese.	
		Daily quantities of food.	Quantities of proteine compounds.	Daily quantities of food.	Quantities of proteine compounds.
		ozs.	ozs.	ozs.	ozs.
Rice	·08	25·000	2·000	26·000	2·080
Dholl	·24	2·857	0·686	0·857	0·206
Mutton	·24	----	----	1·889	0·453
Fish	·20	----	----	1·250	0·250
Tamarind	·04	·500	0·020	0·500	0·020
Curry powder	·04	·500	0·020	0·500	0·020
Vegetables	·03	2·571	0·077	2·571	0·077
Onions	·03	·500	0·015	0·500	0·015
Garlic	·03	·029	·001	0·029	0·001
Butter-milk or tyre (curdled milk)	·07	10·000	0·700	4·286	0·300
Total proteine compounds.	----	----	3·519	----	3·422
Simple imprisonment prisoners, and prisoners for trial receive one-fifth less			·704	----	·684
		A	2·815	B	2·738

Assuming all the proteine compounds ingested in these cases to be assimilated, and transformed without waste into an equal weight of muscle, 1 grm. of muscle, giving by its disintegration 1848 meterkilogs. of force (Frankland, Phil. Mag., xxxii, 188 [and this Jour., xlii, 407]), the muscle so formed would in each case give—

A.	B.
Meterkilogs.	Meterkilogs.
146,842	143,335

the latter quantity being less by 16,677 meterkilogs, than the daily expenditure in the work of the circulation and respiration, given by Helmholtz and Fick at 160,012 meterkilogs. (*Idem*).

It might be objected that the prisoners live in a higher temperature than the subjects, observation on whose circulation and respiration furnished the above data; but the quantity of clothing worn is so small, and loss of heat by evaporation and radiation consequently is so much greater in the one case than it was (probably) in the other, that the effect of this difference of temperature is probably neutralized at least by these attendant conditions. But if it be admitted that the difference of 10 per cent can be so accounted for, the source of external work must be looked for elsewhere than in the disintegration of muscular tissue, as in this case the whole of the muscle formed from the food would be required to furnish the internal work alone. The proportions of proteine compounds given in the Table are above the truth, in many cases considerably so; and the result is, the energy obtained must be considered an exaggeration.—*Phil. Mag.*, Oct. 1867.

4. *On the cost of the Electric Light;* by MOSES G. FARMER.—The time appears to be near at hand when the electric light will be used for a variety of purposes. Is is worth our while to inquire as to its cost. The expense and inconvenience attendant upon the production of electricity upon a large scale has hitherto been an obstacle in the way of using the electric light, except for lecture rooms and a few other purposes. But the recent improvements in the construction of magneto-electric machines and thermo-electric batteries have put in our power to command the services of this beautiful illuminating agent on any desirable scale of magnitude.

In order to examine the question of cost intelligently, let us refer both electrical and illuminating effects to the common measure of power, viz: the foot-pound per minute. The experiments of Mr. Julius Thomson, of Copenhagen, have shown that the power to maintain the light to that of a standard candle for one minute is equal to the raising of a weight not exceeding thirteen pounds, one foot high in that time. I have arrived at a similar result from a reduction of recorded experiments made by Müller, Ritchie, myself, and others. I am satisfied that, where an electric light of not less than eight hundred to one thousand candles is produced, under proper management, the power required will not greatly exceed 15 foot-pounds per minute per candle. For smaller amounts of light the power required will be greater.

Now let us inquire what amount of electricity is the equivalent of, or is represented by 15 foot-pounds per minute. If 100 feet of No. 18 pure copper wire be coiled into a helix and immersed in a pound of water, and if the ends of this wire be connected to the poles of one cell of the Grove battery (pint cup size as used in telegraphing), the temperature of the water will begin to rise at the rate of 1° F. in 9½ minutes, or 0·105° per minute. Now if the temperature of one pound of water be raised one degree (Fah.) per minute, this effect will be the thermal equivalent of 772 pounds raised one foot high in space per minute; the heating effect then, of our Grove cell upon the water is the equivalent of $0{\cdot}105 \times 772 = 81$ (call it 80) foot-pounds per minute.

It is well known that a galvanic battery will perform its maximum work when the external resistance which it encounters is equal to the internal resistance of the battery. I have found the internal resistance of the pint cup Grove cell to be equal, on the average, to that of 100 feet of pure copper wire, No. 18 size. Hence the maximum external effect of the ordinary Grove cell may be set down as the equivalent of 80 foot-pounds per minute, equal to the production of $80 \div 15 = 5\frac{1}{3}$ candle lights. I would not be understood as saying that this amount of light can be produced by a single Grove cell, but that 1,000 cells, if properly arranged, would be capable of evolving somewhat more than 5,000 candle lights from a single lamp.

With sulphuric acid costing 2½ cents, nitric acid 10 cents, zinc 8 cents, and mercury 50 cents per pound, the cost of running 1,000 Grove cells one hour, while doing their maximum work, would be $27.65. This would give for 5,000 candles a cost of about 5½ mills per hour per candle.

The cost of gas light per candle per hour would be about one mill, if gas costs $3.25 per thousand cubic feet, and if one cubic foot per hour gives the light of three candles.

With the Smee battery, carefully managed, the cost of 5,000 candle lights would be about the same as with gas.

Let us now look at the cost of electricity as developed by the magneto-electric machine. The power expended on the machine is consumed in friction, in heating the wires, magnets, etc. On a well built machine which I examined in 1861, 1,100 foot-pounds per minute were required to keep the machine in motion when the circuit was open, and the machine doing no work. But when the circuit was closed 3,200 foot-pounds per minute were required to maintain the same velocity of rotation; nearly all this excess of power (viz., 2,100 foot-pounds) was measured as electricity, about two-thirds (say 1,300 foot-pounds) being expended internally, heating the coils and magnets, etc., and the balance, 800 foot-pounds, measured as external useful effect. Had the external resistance been larger, a greater proportion of the expended power would have appeared as useful effect. Suppose, however, that only 800 foot-pounds per minute could be utilized by this machine and used for illuminating purposes. This would be the equivalent

of 800÷15=53·33 candles, and the total power required (including friction, etc.), would be 3,200÷53·33=60, about sixty foot-pounds per minute per candle.

In the vicinity of Boston, power is furnished, per horse power, at the rate of $180 per year of 313 days of ten hours each, or at the rate of $\frac{\$180}{313\times10}=0{\cdot}0575$ (5¾ cents) per hour. If only one-fourth of this power could be utilized as light $\frac{33{,}000}{4\times15}=550$ candles would be the equivalent of one horse power, and would cost $0·0575÷550=$0.0001046, about one-tenth of a mill per hour per candle, being about one-tenth the cost of gas light.

Let us for a moment take another view of the matter. The average hourly consumption of coal by a good steam engine may be set down at four pounds per hour per horse-power, =(33,000×60)÷4=495,000 foot-pounds from one pound of coal. Utilizing as electricity, and thence light, one-fourth part of this we get 495,000÷4=123,750 foot-pounds, or as light, $\frac{123{,}750}{15\times60}=137.5$ hour candle lights from one pound of coal, through the agency of steam engine and the magneto-electric machine.

With the thermo-electric battery I have been able to develop 130,000 foot-pounds of electricity from one pound of coal=$\frac{130{,}000}{15\times60}$ =144·4=to about 144 candle lights.

There is still another point of view worthy our attention. Common gas coal will yield about ten thousand cubic feet of gas per ton. This, at three hour candle lights per cubic foot, would give (3×10,000)÷2,000=15 hour candle-lights per pound of coal. About twenty-five cubic feet of illuminating gas weigh one pound. Hence one pound of gas, after it is made from the coal, will yield a light equal to that of a candle for seventy-five hours. One pound of pure carbon, wholly burned to carbonic acid gas, yields 14,500 units of heat, equal to 772×14,500=11,200,000, or 11⅕ millions of foot-pounds of work: Hence, were the total energy of one pound of pure carbon converted into light, it would be equivalent to one candle light for the time of $\frac{11{,}200{,}000}{15\times365\times24\times60}=1\frac{5}{12}$; or one year and five months.

To recapitulate: the gas made from one pound of coal would yield a candle light for fifteen hours; one pound of the gas would yield a light equal to one candle for seventy-five hours; but could all the energy in a pound of carbon be converted into light, it would be equivalent to the burning of a candle for 12,410 hours.

Thus it will appear that by our ordinary methods of gas lighting we utilize much less than one per cent of the energy stored in the coal. I think we may reasonably expect that electricity, as developed by the thermo-electric battery, the magneto-electric

machine, or some still more efficient apparatus, will help us in some way to bridge the chasm between fifteen and twelve thousand hour candle lights from a pound of coal.—*Scientific American.*

3. *On a new form of Dynamo-magnetic Machine;* by William Ladd, F.R.A.S.—It is now thirty-six years since Faraday first published his celebrated 'Researches in Electricity and Magnetism;' the foundation then laid has been receiving additional strength as the superstructure has progressed. Faraday has gone to his rest, but the name he always tried to hide behind his philosophy will shine brighter and brighter, until the top stone is raised in future ages. The machine I am about to describe is a part of that superstructure. The repeated application to me for a machine that would give a sufficient light for the purposes of lecture demonstration and would dispense with the galvanic battery has induced me to give considerable attention to the subject, and I must leave you to judge how far this machine meets, not only that requirement, but also that of lighthouse illumination.

Perhaps the most powerful magneto-electric machine was that constructed by Mr. Wilde, the electro-magnet receiving its charge from sixteen permanent steel magnets, but Siemens and Wheatstone have shown that the residual magnetism left in soft iron, after being under the influence of a battery, or permanent steel magnets, can be augmented from the currents generated by itself, by merely applying dynamic force to the revolving armature, containing a coil of copper wire, the terminals of which are connected with the wire surrounding the electro-magnet; and although great effects were produced *in* the electro-magnet, the current itself could only be made available by its partial or total disruption—in the former case diminishing the power of electro-magnet, and in the latter reducing it to its normal condition. But in the machine I have constructed, the power of the electro-magnet is kept up, whilst a separate current, to be applied to any useful purpose, can be drawn off by means of an independent arrangement.

It consists chiefly of two plates of iron; to both ends of each plate is fixed a portion of a hollow cylinder; these plates are then placed a certain distance apart, and insulated from each other in such a manner that the cylindrical pieces will form two hollow circular passages; into these spaces two armatures (known as Siemens' armatures) are placed. The plates are surrounded by a quantity of stout copper wire, connected together, the two terminals of which are brought into connection with the commutator of the smaller armature, so that each change of polarity in the armature will augment the magnetism. When the machine is first made it is only requisite to pass a current from a small cell of Smee's, or any other element, for an instant, to give the iron a polarity; it will then retain a sufficient amount of magnetism for all future work.

If the armature in connection with the electro-magnet is made to rotate, there will be a very feeble current generated in it; this passing round the electro-magnet, will increase its power with

every additional impulse. It will thus be seen that the only limit to the power of the machine is the rapidity with which the armature is made to rotate, which is entirely dependent on the amount of dynamic force employed. But the great improvement in this machine is the introduction of the second armature, which, although it takes off very powerful currents generated in its wire by the increased magnetism, does not at all interfere with the primary current of the electro-magnet.

The machine now at the Paris Exhibition measures about 24 in. in length, 12 in. in width, and stands 7 in. high; but this being imperfectly constructed as to its proportions, the results obtained are, no doubt, much less than they would be with a properly constructed machine. Still, I found it would keep 50 in. of platinum wire, ·01 in. in diameter, incandescent, and when a small voltameter was placed in circuit with the second armature it would give off 250 cubic centimeters of gas per minute, and in connection with an electric regulator would give a light equal to about thirty-five Grove's or Bunsen's elements, the driving power expended being less than one horse.

I have now to describe a machine on the same principle as that just noticed, but which, instead of having two independent armatures running in separate grooves, has two armatures fixed end to end, so as to appear like one continuous armature, but so placed with reference to each other that their magnetic axes shall be at right angles. By this arrangement there is only one opening required for the armature, enabling us to take full advantage of the horse-shoe form of electro-magnet. The shoes of the electro-magnet and armatures are so proportioned to each other that there is an actual break in the magnetic circuit with reference to each armature alternately, but by their disposition at right angles there never is an actual break in the complete magnetic circuit, but simply a shifting of the principal portion of the magnetic force from one armature to the other at the precise moment required to produce the best effect. The mechanical advantages obtained by this disposition of parts must be at once obvious, as one pair of bearings and set of driving gear is dispensed with, and from the fixing of the two armatures together the currents are made to flow perfectly isochronously. It may be found of advantage to vary the angle of position of the armatures with reference to each other, according to the speed at which they are driven, so that the current given off by the exciting armature may at the precise moment exert its full effect upon the electro-magnet, and thus produce the best effect in the second armature.—*The Laboratory*, i, 407, Sept. 14, 1867.

4. *On a Real Image Stereoscope;* by J. Clerk Maxwell, F.R.S.—In all stereoscopes there is an optical arrangement by which the right eye sees an image of one picture, and the left eye that of another. These images ought to be apparently in the same place and at the distance of most distinct vision. In ordinary stereoscopes these images are virtual, and the observer has to place

his two eyes near two apertures, and he sees the united images, as it were, behind the optical apparatus.

In the stereoscope which I have had made by Messrs. Elliott Brothers the observer stands at a short distance from the apparatus, and looks with both eyes at a large lens, and the image appears as a real object close to the lens.

The stereoscope consists of a board about two feet long, on which is placed—1. A vertical frame to hold the pair of pictures, which may be an ordinary stereoscopic slide turned upside down. 2. A sliding piece near the middle of the board, containing two lenses of 6 in. focal length, placed side by side, with their centers about 1 inch and a quarter apart. 3. A frame containing a large lens of about 8 in. focal length and 3 in. diameter.

The observer stands with his eyes about two feet from the large lens. With his right eye he sees the real image of the left hand picture formed by the left hand lens in the air close to the large lens; and with the left eye he sees the real image of the other picture formed by the other lens in the same place. The united images look like a real object in the air close to the large lens. This image may be magnified or diminished at pleasure, by sliding the piece containing the two lenses nearer to or farther from the picture.—*The Laboratory*, i, 408, Sept. 14, 1867.

[We regret to announce that this valuable little journal is compelled to suspend publication, for want of sufficient support. In the twenty-sixth number which completes the first volume, the editor, Mr. John Cargill Brough, after stating the above facts, and alluding to the high scientific character of its original articles (in which we heartily concur), hints that the Laboratory may reappear in another form at the commencement of the next year].

II. MINERALOGY AND GEOLOGY.

1. *Extract from a paper on Borates and other Minerals in Anhydrite and Gypsum of Nova Scotia;* by Prof. How, Windsor, N. S.*—*Silicoborocalcite, a new mineral.*—The mineral exhibits very different degrees of hardness; the hardest specimens are found imbedded in anhydrite, the softest in gypsum; both matrices occurring in the same deposit, at Brookville, about three miles south of Windsor. The hardest mineral is in white, rounded, often egg-shaped nodules, brittle and of nearly even and smooth fracture, which is observed in the broken masses giving almost flat surfaces continuous with those of the matrix; these surfaces are dull. The nodules are generally about the size of filberts or pigeons' eggs; the largest specimen I have, is a fragment of about two inches diameter; they sometimes show when detached, a sub-vitreous luster in the exterior. The mineral is translucent in thin fragments, its powder is seen under the microscope to be transparent and crystalline; the form is possibly rhombic. The greatest hardness is about 3·5; specific gravity, 2·55. Before the blowpipe hard fragments

* The paper is to appear in the L. E. & D. Phil. Mag.

decrepitate strongly and all fuse readily to a clear colorless bead, the inner flame assuming a green color which is quite deep when the mineral has lain for some time in water. Fragments fuse even in lamp-flame to a colorless blebby glass which when further heated B.B., froths considerably and finally becomes quite clear. The clear bead can be rendered opaque by sudden insertion in, and rapid removal from, the oxydizing flame, probably from formation of bubbles of BO_3 which cannot escape till the bead is further heated, which then becomes clear again and remains so on prolonged heating. These reactions distinguish the mineral from natroborocalcite which colors the flame yellow and gives a clear bead rendered opaque by the method just given, but which on prolonged heating is so reduced in bulk as to leave the wire-loop nearly hollow: the flame becomes decidedly greenish-yellow during this operation. In the former case the silica present is no doubt the cause of the permanent transparency. A minute quantity of either mineral with a drop of dilute HCl gives the BO_3 test most readily. The new borate before ignition gelatinizes perfectly in two or three minutes when its powder is stirred up with cold HCl, after ignition also when left for some time. In the closed tube it decrepitates and gives much water. In the following analyses, the results under I, were from a nodule in anhydrite, those under II, from several fragments, some perfectly dull, others lustrous in parts of the exterior. The absence of soda was proved by testing after removal of BO_3 and SiO_2 by heating with CaF and HSO_4; the BO_3 was estimated by deficiency after gravimetrical determinations of the other constituents in the regular way. Analysis of the air-dry hard mineral gave:

	I.			II.
Water,	11·51	11·60	11·55	11·62
Lime,	28·90		28·90	28·04
Sulphuric acid,		1·03	1·03	0·80
Magnesia,		trace	trace	
Silica,	15·12	15·27	15·19	15·44
Boracic acid,			43·33	44·10
			100·00	100·00

The softest mineral, found in nodules in gypsum, is so unlike the preceding in hardness that at first I thought it might be efflorescent glauber salt, which I had formerly found here in the same matrix. It is like soft chalk or coherent flour. Its flame and blowpipe reactions, except that it does not decrepitate, are those of the harder mineral; it gives the turmeric coloration the same way, and gelatinizes in similar circumstances with equal ease. Analysis of a specimen like flour, air-dried, gave:

	III.
Water,	12·20
Lime,	28·85
Sulphuric acid,	1·86
Magnesia,	trace
Silica,	14·64
Boracic acid,	42·45
	100·00

These results agree so closely with the foregoing from different specimens in a distinct matrix, that there can be no doubt they all relate to a definite mineral whose composition is constant in its varying physical conditions. The percentages correspond remarkably well with those calculated from the formula to which they lead. The results placed below, as found, are those of the analysis III, just given, after deducting the amount of $CaO\,SO_3$, 2HO, equal to the SO_3 obtained, which is much greater in this than in the preceding analyses whose numbers are so obviously similar, that deduction in all is quite superfluous.

	Calculated.		Found.
5HO =	45	11·43	11·84
4CaO =	112	28·44	28·69
$2SiO_2$ =	61·62	15·65	15·25
$5BO_3$ =	175·20	44·48	44·22
	393·82	100·00	100·00

Of the various modes in which the constituents of the mineral may be arranged, I prefer the following, and therefore using the notation so far employed in mineralogy, propose the formula,

$$2CaOSiO_2+2(CaO\ 2BO_3,\ HO)+BO_3,\ 3HO,$$

as that of the new mineral, to which I give the name Silicoborocalcite, chosen as companion to that of natroborocalcite, the essential difference in chemical composition between minerals found in the same region, and even in the same matrix occasionally, as will be mentioned, being clearly indicated by these terms; the formula of the latter, according to my own results, when rewritten to include some identical grouping, is

$$NaO\ 2BO_3,\ 10HO+2(CaO\ BO_3,\ HO)+BO_3,\ 3HO.$$

For comparison sake, I add the formula of cryptomorphite, the other borate found in gypsum here, also rewritten on the same plan as the preceding,

$$NaO\ 2BO_3,\ 6HO+3(CaO\ 2BO_3,\ HO)+BO_3,\ 3HO.$$

Interesting relations are thus made to appear between these geologically allied minerals. (For original formulas, etc., see this Journal, 1857 and 1861.) The constituents of silicoborocalcite are those of datholite, the only other known hydrated silicated borate of calcium, for which Berzelius gave the formula,

$$CaO\ BO_3+CaO\ 2SiO_2+HO.$$

This expression exhibits proportions very unlike those shown above to exist in the new borate. In datholite, as in all silicated borates, the boracic acid is sometimes held to be basic, (Dana, Min., 4th ed. i, 207 and ii, 335) on this view, including water as basic, the ratio of O in SiO_2 to that in all the constituents is 2 : 3 in silicoborocalcite as 2 : 12, which is so unlike that in any known compound that SiO_2 cannot be the only acid. The formula I have proposed contains 2 of wollastonite, 2 of normal hydrated biborate of calcium, and one of sassolin. While datholite and silicoborocalcite

are quantitatively unlike and physically different, on comparing the well crystallized specimens of the former with the nodules of the latter there is a remarkable resemblance between these and the exceptional state in which Whitney formed datholite near Lake Superior, viz., in perfectly white and opaque nodules like the finest marble or some kinds of Wedgewood ware. (Supplements to Dana's Min., this Journal, May, 1860, and May, 1861). The *crystals* of silicoborocalcite may yet be met with. I found a very small amount of silica, perhaps 2 or 3 tenths per cent, in the anhydrite and gypsum (not earthy) matrices of the new borate.

Selenite is most frequently found with silicoborocalcite and aragonite occasionally. The new borate has been met with in gypsum from Newport, about six miles east of Windsor; it was identical by its blowpipe reaction and qualitative analysis, and its powder gelatinized like that of the Brookville mineral. The Newport mineral appeared the more crystalline.

New localities for Natroborocalcite. Both Brookville and Newport.—At the former an impure earthy gypsum has silicoborocalcite and selenite together in nodules, and natroborocalcite in distinct nodules, sometimes both kinds in a seam of fibrous gypsum. Other purer kinds of white gypsum and selenite also, hold it alone. Anhydrite does not contain it. At Newport, it is in white gypsum. At both places the nodules are harder inside than out; hardness about as 3 : 1 respectively; qualitative analysis showed HO, CaO, BO_3, NaO; in several specimens, the microscope showed distinct prisms; hence the mineral is concluded to be natroborocalcite.

Comparison of theoretical and actual percentages from formulas and analyses of this mineral by Lunge and How.*

How's original formula, $NaO\ 2BO_3+2CaO\ 3BO_3+15HO$.

Lunge's " " $2(NaO\ 2BO_3)+5(CaO\ 2BO_3)+42HO$.

	Lunge.		How.	
	Calc.	Found.	Calc.	Found.
Soda,	5·82	5·58	7·82	7·21
Lime,	12·95	12·69	14·12	14·20
Magnesia,		·50		
Water,	35·49	36·85	34·04	34·49
Boracic acid,	45·74	44·38	44·02	44·10
	100·00	100·00	100·00	100·00

As regards *all* the constituents, I see no reason, on comparison of statements, to accept Dr. L.'s formula in place of my own.

2. *Pteropodes Siluriens de la Bohême*, Introduction. (Extrait du Syst. Silur. du Centre de la Bohême, vol. iii); par JOACHIM BARRANDE.—The Geologist Barrande here announces the publication of vol. iii of his great work on the Bohemian Silurian System, treating of the *Pteropods of the Paleozoic*. The volume is illustrated by 16 lithographic plates. The author admits among Silurian Pteropods, 9 genera and 246 species; 83 species of the genus *Conularia*, 52 of *Tentaculites*, 84 of *Hyolithes* (Eichwald), 3 of *Hemiceratites* (Eichw.), 4 of *Coleoprion*, 7 of *Pterotheca*, 3 of

* See Chem. News, Feb. 22 and Ap. 19, 1867.

Salterella, 9 of *Styliola*, 1 of *Phragmotheca*. Seven out of the 9 genera are represented in the Bohemian rocks, while the United States, Britain, and Russia, have afforded each only four. Barrande refers these Pteropod genera to the Cephalopods. He states that the plates already engraved for his volumes on Bohemian fossil Cephalopods number *four hundred*.

3. *Musée Teyler:* Catalogue systématique de la Collection Paléontologique, par J. C. WINKLER. Cinquième et Sixième Livraisons. Harlem, 1867.—These two parts complete this valuable work, which is one of the best catalogues of the kind ever published.

4. *Siluria: A history of the oldest rocks in the British Isles, and other countries, with sketches of the origin and distribution of Native Gold, the general succession of Geological Formations, and changes of the Earth's surface;* by Sir RODERICK IMPEY MURCHISON, Bart. K.C.B., etc. 566 pp. 8vo, with 41 plates. London, 1867. (John Murray, Albemarle street).—Siluria is a work of universal interest—as it treats of the foundation rocks and earliest life in geology, and of all countries. Its illustrious author who early began to write out the history, passed it through its third edition in 1859, and now has brought it up to the present time and issued the fourth. The present volume contains besides additions of facts from Great Britain, Europe, and other eastern continents, much from the labors of Sir William Logan in Canada, to whom the work is dedicated.

5. *Materialien zur Mineralogie Russlands*, von NIKOLAI VON KOKSCHAROW.—The fifth volume of this great work of General von Kokscharof on Russian Mineralogy has been received by us, to page 192. It contains appendices to many of the species before described; and also general and crystallographic descriptions of the following minerals: Celestine, Chrysolite, Leuchtenbergite, Chalcolite, Kaemmererite, Psilomelane, Chrysocolla, Chalcophyllite, Limonite, Orthoclase, Copper, Nickel, Laumontite, Stilpnosiderite, Zoisite, Andalusite, Native Platinum.

III. BOTANY AND ZOOLOGY.

1. *Botanical Necrology for the year* 1867.

Dr. HENRY P. SARTWELL, died at Penn Yan, New York, on the 15th of November, at the age of 75 years. He was, we believe, indigenous to the western part of the State of New York, and when a medical student resided at Gorham, Ontario county. More than forty years ago he was established as a physician in the neighboring town of Penn Yan, where he passed his honorable and useful life, engaged to the last in the practice of his profession. It is said that the illness of which he died was brought on by overexertion in attendance at the bed-side of a sick friend. He was fond of all branches of natural history, and a diligent observer and collector in more than one; but in botany, he has secured an enduring reputation. He was in his way a model local botanist. He thoroughly explored the district within his reach; he prepared

admirable specimens in great numbers, and distributed them with a free hand. Few botanists in this country have contributed to so many herbaria, home or foreign, none more disinterestedly and generously. He accumulated a large herbarium, specially rich and attractive in plants of Western New York, in Carices and Ferns. Desirous of ensuring its preservation and future usefulness, and needing in his old age the very moderate sum which it would bring him, he a few years ago transferred his herbarium to Hamilton College, where it is valued and well-cared for. Most local botanists, when they have nearly exhausted the resources of the district they are confined to, are liable to sink into inactivity. Dr. Sartwell avoided this destiny, and prolonged to the last his enjoyment and usefulness, by making a speciality of the great genus *Carex*. Dewey, Torrey, Tuckerman, Carey, Boott, all who have published within the last thirty years upon this genus, have had frequent occasion to acknowledge their obligations to him; and he erected for himself a monument of his zeal and devotion, and a testimony to his powers of observation, in his *Carices Americæ Septentrionalis Exsiccatæ*, the first part of which was issued in the year 1848, the second in 1850; while his interest and activity in the study continued with little abatement down to the last year or two. He published nothing else, we believe, excepting a *Catalogue of the Plants growing in the vicinity of Penn Yan*; but he contributed no little to the value of the publications of others, especially to those of the writer of this notice and to the Flora of the State of New York. The *Carex* which had been dedicated to Dr. Sartwell has proved to be identical with an old European species; but a very distinct and peculiar genus of Compositæ found in S. W. Texas, keeps up the name of *Sartwellia*. His most intimate associate in caricological study survived him only one month.

Professor Chester Dewey, died at Rochester, New York, December 13, having completed the 83d year of his age. "He was born at Sheffield, Massachusetts, Oct. 25, 1784; was graduated at Williams College in 1806; studied for the ministry; was licensed to preach in 1808, and during the latter half of that year officiated in Tyringham in Western Massachusetts. The same year he accepted a tutorship in Williams College, and in 1810 was appointed Professor of mathematics and natural philosophy, an office which he discharged for seventeen years. During his connection with the College he did much to advance the standard of scholarship and enlarge the cause of study in his own and kindred departments. Between 1827 and 1836 he was principal of the "Gymnasium," a high school for boys in Pittsfield, Mass. In the latter year he removed to this city [Rochester], and became principal of the Rochester Collegiate Institute, which post he held until 1850, when he was elected Professor of chemistry and natural philosophy in the Rochester University. He was actively engaged in the duties of that position till 1860, when he retired at the age of seventy-seven, though he continued to teach to some extent till his eightieth year. The last four years he has passed in easy and dignified retirement, happy in the society of his family and friends,

beloved and respected by all, and occupying himself still with his scientific studies and with meteorological observations, which he conducted with great care and regularity."

Dr. Dewey was an early and a frequent contributor to this Journal, upon several subjects, but especially upon that with which his name is inseparably connected, the *Carices* of North America. His *Caricography*, commenced in 1824, was continued year after year with few breaks, down to the close of 1866, when it terminated with a general "Index to Species." It is not for us to speak particularly of the merits of this elaborate monograph, patiently prosecuted through more than forty years. This and the monograph of Schweinitz and Torrey laid the foundation and ensured the popularity of the study of Sedges in this country. But while the latter, systematic in arrangement, was published as a whole in 1825, Dr. Dewey's, carried on without particular order, extended through a life-time, and represents both the earlier and the later knowledge. What is needed to render these stores of observation and their permanent results most available, is a systematic digest or synopsis, something like that which the author contributed to Wood's Botany, in the article *Carex*, but with all the more important references. Hopes were entertained that he might be able to crown his life's work in this way. But at past four-score and ten this could not well be expected. Beyond this favorite genus, Prof. Dewey's botanical writings were few; the most considerable was his *History of the Herbaceous Plants of Massachusetts*, published under the authority of the State, being the companion volume to the better known Report on the Trees and Shrubs, by Mr. Emerson. Botany was one of the occupations of Prof. Dewey's leisure hours; his long life was mainly devoted to education. Turning his attention to a special yet almost inexhaustible subject, however, and laboring perseveringly and faithfully, although under many disadvantages, he has permanently and honorably impressed his name upon the science, in which the Californian Umbelliferous genus *Deweya* has recognized his services. He was an excellent, simple-hearted, devout man, a fine specimen of the Western New Englander of the Old School.

The lovers of *Carex*, so numerous in this country, will cherish the memory of these two venerable men, Sartwell and Dewey, long associated in congenial pursuits, and gone to their rest together. May the turf of the sedges they loved, and which cover, or ought to cover, the low mounds under which their dust reposes, keep them perennially green, and adorn them each returning spring with their sober blossoms! A. G.

Our accustomed notices of European and other botanists deceased, not having been fully made up for the year 1866, we include in the following brief announcement the principal names.

Prof. George H. Mettenius, of Leipsic University, the most promising if not already the best Pteridologist of the day, son-in-law of Prof. Braun, died of cholera, August 18, 1866, in the 43d year of his age.

Prof. D. F. L. von SCHLECHTENDAL, of the University of Halle, the venerable editor of the Linnæa and of the Botanische Zeitung, long an active botanist (the published list of his articles and other works reaches the number of 154), died October 12, 1866, at the age of 82 years.

Dr. THEODORE KOTSCHY of Vienna, a well known explorer in the East, author of a Monograph of Oriental Oaks, and other publications of merit, died June 11, 1866, at the age of 53.

Prof. WM. GASPARRINI, of Naples, died about the close of the year 1866, at an advanced age.

Dr. OTTO BERG, of Berlin, author of a Monograph of *Myrtaceæ*, and of several works upon pharmaceutical botany, died in November, 1866, at the age of 51.

GUSTAVUS MANDON, an excellent botanical explorer and collector, who distributed extensive collections made in Bolivia, died at Poitiers, France, December 30, 1866.

Dr. CHARLES G. B. DAUBENY, Professor of Botany and Rural Economy in the University of Oxford, died on the 12th of December last. A. G.

2. *The Journal of Anatomy and Physiology.**—The existence of this journal dates back one year, but the slight attention which it has received on this side the Atlantic has led to the preparation of the following notice.

The first series consists of two numbers issued in Nov. 1866 and May 1867, and embraces 378 large octavo pages and 15 lithographic plates distributed among 27 articles, about one-fifth of the space being devoted to Reviews, Reports on the progress of Anatomy and Physiology and notices of recent Dutch and Scandinavian contributions. In addition to the distinguished professors under whose care the journal is to be continued, the 1st series bears the names of Alfred Newton, E. Percival Wright and J. W. Clark. The expectations raised by the announcement of its scope and purpose and by the names of its conductors are well justified by the variety and character of its contents. The opening article of the 1st series, the address of Prof. Humphrey before the Physiological section of the Nottingham meeting of the British Association, is remarkable in general for its freedom from the scientific mutual admiration which so often mars such productions, and in particular for the equal ability and fairness with which it discusses the great problem of the day, the origin of species, and for the much-needed suggestions to those who dread each onward step in Science as an attack upon religion, that "true religion is unassailable, its foundation being laid deep in man's consciousness and God's work," and that it does not consist in "drawing arguments from analogy and in insisting upon certain literal interpretations of the physical medium through which spiritual truth has been conveyed to us."

* Conducted by George M. Humphrey, M.D., F.R.S., Professor of Anatomy in the University of Cambridge, and Wm. Turner, M.B., F.R.S.E., Professor of Anatomy in the University of Edinburg. Second Series, No. 1. Nov. 1867. Macmillan & Co. (In half-yearly numbers, at six shillings each.)

Prof. Humphrey (we presume) also contributes a long and impartial review of Owen's Anatomy and Physiology of Vertebrates, in which, while generally admiring this last work of the great anatomist, he regrets the continuance of the unhappy controversy as to the peculiarities of the human brain, and comments upon the apparent non-recognition of the really unsettled state of opinion upon two important points in homology concerning which Prof. Owen holds very decided opinions, viz., the morphological relations of the scapular arch of all vertebrates with the skull, and the homology of the fore and hind limbs. Upon the latter question, Prof. Humphrey is eminently well qualified to speak, for he was the first English anatomist to recognize, though from a functional point of view, the antagonistic relation of at least the proximal segments of the limbs, which nearly all anatomists attempt to force into a parallel position, and which Prof. Owen, like Barclay and Flourens, regard as simple serial repetitions of each other, the *convexity* of the knee corresponding with the *concavity* of the elbow, and *vice versa*.

Mr. John Wood has an interesting paper on human muscular variations, in which he shows that many of them are comparable with normal conditions in the lower animals, but adds the startling, and, we think unwarranted, suggestion that those variations which cannot be so referred may be "indications of a higher development of the human frame" in time to come.

Prof. Huxley describes two skulls of which one is the widest, the other the narrowest, he had ever seen; yet the sagittal suture was completely obliterated in the former, and open in the latter, showing that in these cases, at least, the form of the skull was determined by something besides the condition of the sutures.

Prof. Turner adds a fourth to his three cases already reported by Prof. Wyman, Dr. Günther and Prof. Agassiz, of male fishes carrying the ova in the mouth during incubation.

No. ii. opens with a very interesting account by Mr. Flower and Dr. Murie of the dissection of a Bushwoman, whose characteristics, especially the proportion of the limbs, showed no approximation toward what are generally regarded as pithecoid features of the colored races; the spread of the arms was full two inches *less* than the height of the body.

Dr. Cleland advances some weighty arguments against the soundness of the generally accepted theory of the intercostal muscles.

In a valuable and suggestive paper on the anatomy of the Chimpanzee, Prof. Humphrey discusses at some length the significance of the terms "hand" and "foot" and inclines to think the name "Cheiropoda" more appropriate than Quadrumana. He also alludes to the "high function" of the foot and of all the human organs, adding that his feelings on the subject incline him "rather to search for and overrate than to ignore the physical peculiarities of man." But while it is certain that in pure Anatomy and Physiology, we ought to insist strongly upon the functional or teleological value of organs, and are justified in seeking for physical peculiarities

commensurate with the psychical endowments of man, yet it seems to us that for zoological purposes, functions must be wholly ignored and that we have really no alternative between the entire separation of Homo from the rest of creation on account of his having an immortal soul, and his admission as an animal not only into the type of vertebrates, and the class of mammalia, but also into whatever order, or even family, may be warranted by purely structural considerations. Teleologically man is a spiritual being, a discrete degree above the beasts that perish, but morphologically, (and nothing but morphology is of value in classification) he is at least an animal, a vertebrate, and a mammal.

Space will not permit a special notice of the other articles. No. 1, of the 2d series, just received, is reduced slightly in size and in the number of plates, and considerably in price, though it contains more pages than either of the preceding numbers, and is quite as valuable for both the variety and character of the articles. Mr. Mivart concludes an exhaustive survey of the osteology and classification of the Insectivora; there are anatomical papers by Prof. Turner, Dr. MacAllister, Dr. Hair and Dr. Dohrn, cases of deformity with morphological and physiological deductions therefrom by Prof. Humphrey, Dr. Chiene and Mr. Goodman, with several microscopical and physiological papers, and the usual Reports on the Progress of Anatomy and Physiology; while as in the other numbers, the concluding pages are devoted to notices and abstracts of recent Dutch and Scandinavian contributions to those sciences.

The value of these reports and notices can hardly be over-estimated, and indeed, if we would make any suggestion of a change, it would be to increase their number and completeness, even if it involved the omission of some special papers, which, though very important, do not readily furnish material for thought and would not lose by waiting for a little later appearance in the Transactions of societies: we may add too, the wish that this journal may in time be issued quarterly, so that we may be as soon as possible informed upon the progress of science all over the world. Nowhere is this information more needed than in America; next to the deficiency in the number of workers, the great defect of our Science lies in our slight acquaintance with, and recognition of, the labors of our co-workers abroad, especially in France and Germany. Not that the same thing does not exist elsewhere; indeed a good illustration exists in the paper of Dr. Lighbody in No. 1, where are described little bodies connected with the nerves of the cornea, which Prof. Krause (No. ii, p. 346,) states have been described or referred to four times since the year 1858 in both French and German publications. The success, therefore, of this or of any journal which shall not only give us in detail the labors of its contributors but shall keep us posted upon the progress of science everywhere, and so both show us where to look for desired information and prevent our doing over what has been done before, is most earnestly to be wished for; and though we in America, may feel, and justly, that we have now a competent scientific tribunal, and that we nei-

ther need nor ought to send our contributions to other lands for judgment, yet it by no means follows that we are independent of the information they offer; nor will it prevent our being severely criticised if we persist in rediscovering what is already well known, and in elaborating what is already thoroughly understood. And while we trust the time is not far distant when America shall have her own journal of Anatomy and Physiology, yet till that time comes we must either avail ourselves of what is offered by other countries, or be continually behind the times. B. G. W.

3. *On the actual state of our Information relative to the 'Leporide,' or Hybrid between Hare and Rabbit*; by Dr. PIGEAUX.—Are there any sexual relations between the hare and rabbit in a state of nature to which it would be possible to attribute the creation of a mixed or intermediate species, to be named on account of external configuration, *Leporide?* The ancients, and indeed some of the moderns, deceived by the colors and special forms of certain varieties of rabbits common in the south of Europe and very abundant in Asia Minor, have believed this to be the case. Such varieties are found in some departments of the east of France and along the banks of the Rhône. These are, after all, merely rabbits which burrow, and are born without fur and with the eyes closed. Such are the *Léporides* of M. Roux, and those also which have been and are perhaps still called 'Leporides' at the Jardin d'Acclimatation in Paris. These rabbits pair voluntarily, and are productive either amongst themselves or in conjunction with the ordinary domestic rabbit. I have had in my possession some of them which, from their appearance, might almost have been mistaken for hares, having the tip of the ears black and the inferior surface of the belly and of the thighs tawny; nevertheless, by all characters distinctive of the species, they were never anything but rabbits. Thus I am able to negative the pretensions of M. Roux to having created a race of fertile hybrids begotten through a male hare and several female rabbits.

It is, however, by no means difficult to bring about a connexion between the hare and rabbit in a state of domestication; but for success we must not persist in uniting adult individuals unaccustomed to living together previously. In such a case the female nearly always kills the male, bleeding him at the jugular, or, unless the hutch be securely fastened, succeeds in dislodging him. This will occur indeed sometimes when a young male leveret has been brought up with young female rabbits, as soon as they become adult, if the cage be to constrained in its dimensions. In order that the experiment may succeed, it is necessary to provide a cage of a certain extent, say of some meters, barred in some portions and pannelled in others, so that the animals may escape observation at pleasure. It is well also to leave several females with the young male, in order that he may have some range for choice. Such measures were adopted by M. ——, of Nanterre, near Paris, whose success has been as complete as it is perfectly attested and indubitable. Several female rabbits were rendered pregnant by

the agency of a single male hare existing in his menagerie; he has further been able to rear to the adult state a number of the *mongrels* or, rather, *mules* so obtained between the two species. There were both males and females, apparently strong and well developed; and these paired, but have not been productive, as far as I know, hitherto. I would not deny to these mongrels a fecundity similar in degree to that which is sometimes found in the cross between ass and mare; but such a case is only exceptional, and we can neither fear nor indeed hope to create a new race: so that from this point of view the *Leporides* do not exist.

The instance cited by M. Albert Geoffroy Saint-Hilaire, in which a female hare covered by a male rabbit gave birth to a young already covered with fur, and having the eyes open, is a most remarkable one; it could, however, be merely a case of a cross retaining the form of the mother, and no more fertile than in the case of those hybrids between the ass and the horse in which the latter animal (the male) gives the predominant character to the offspring.

These experiments may be repeated and varied, proceeding with very young animals brought up together and enjoying a certain liberty, although confined in the hutch. It is of especial importance, in breeding with the male hare, to provide several females, whether of rabbit or of hare, always, however, isolating them as soon as they are ready to bring forth (in twenty-eight or thirty days). That the hare, when in good condition will produce several times a year admits of no doubt; but as she does not burrow, it is necessary to furnish her with a sufficient quantity of twigs, and to keep them extremely fresh and clean. Although in captivity the hare usually produces only one or two young, she has been known to bring forth three, and to rear them with great tenderness; it is, however, necessary to remove them early from the male, and even from the female, who will often strangle them as soon as they are capable of living independently, especially if they are about pairing again.

The rearing of hares in captivity is but a thankless task, as they do not live long, wanting a sufficient space for running; their flesh, also, is insipid, unless, indeed, they are let loose some months previously in an area perfectly free from rabbits; for between these two species there rages a most inveterate war; and a single rabbit would with ease strangle fifty hares in one night. The female, also, is not very productive, and ceases to bear after the third year.

To sum up, therefore, we would affirm that *Leporides* exist undoubtedly under both forms, with predominance of the hare or of the rabbit; but as a species, or even a variety, we cannot admit them, since, like all other crosses, they have merely an accidental productiveness. Their utility moreover is but slender, the flesh having neither the whiteness of the rabbit nor the fine flavor of the hare. Pretty much the same thing may be said of the hares reared in hutches; their flesh lacks flavor, and their multiplication

is too limited to render them a profitable object of industry.—*Bulletin mensuel de la Société Impériale zool. d'Acclimatation*, 2me série, tome iii. No. 7, July 1866.—*From the Ann. Mag. Nat. Hist.*, III, xx, 75.

3. *A History of the Fishes of Massachusetts;* by DAVID HUMPHREYS STORER, M.D., A.A.S., etc. Reprinted from the Memoirs of the American Academy of Arts and Sciences. 288 pp. 4to, with 39 lithographic plates. Cambridge and Boston, 1867. (Welch & Bigelow, and Dakin & Metcalf).—The first Report of Dr. Storer on the Fishes of Massachusetts, was prepared in 1839, and issued without illustrations. Since these his preliminary labors, he has given the subject a thorough investigation, and in the papers of which this volume consists, presents his completed work, containing new descriptions of all the species, with admirable lithographs of over 130 species by Professor Agassiz's skillful artist, Mr. Sonrel. The work is one of great value to all interested in Zoological science, and is especially important to those who wish to learn anything about the fishes of the American coast.

4. *Index to vol. I to XI, of Observations on the Genus Unio*, together with Description of new species of the Family Unionidæ; and Descriptions of new species of the Melanidæ, Paludinæ, Helicidæ, etc., read before the American Philosophical Society and the Academy of Natural Sciences of Philadelphia, from 1827 to 1863: by ISAAC LEA, LL.D., etc. 64 pp. 4to. Philadelphia, 1867. —This elegantly printed Index forms a fitting close to the long series of contributions to Zoology, which Dr. Lea, at large personal expense, has been making through the past *forty* years. The Index, as the prefatory notice states, was prepared for the author of the work by his friend James Lewis, M. D., of Mohawk, N. Y., of whom he adds, "whose thorough knowledge in this branch of Natural History is so well known."

IV. MISCELLANEOUS SCIENTIFIC INTELLIGENCE.

1. *Earthquake in Kansas;* by JOHN D. PARKER, Prof. Nat. Sci. Lincoln College, Topeka, Kansas. (Communicated for this Journal.)—The earthquake of April 24, 1867, was more severe and extensive in its effects than any other which has occurred within the memory of the oldest inhabitant. Between one and three o'clock on that calendar day, two distinct earth-waves passed over the State of Kansas, together with large portions of the States of Nebraska, Missouri, Illinois, Indiana, and are reported to have reached Ohio. Almost the entire population of two or three of the first named States was precipitated in one hurrying mass into the streets. The most massive buildings swayed back and forth and seemed ready to fall. A train on the Pacific railroad was stopped, the engineer and fireman jumping off under the impression that the engine was on the point of blowing up, clocks were stopped, and animals hurried about the fields in alarm, while some stood still in the furrow. The earthquake was accompanied by a noise likened by

some to the roar of distant thunder, or to the rumbling of artillery over a pavement. A large mass of material, referring to it has been collected, out of which the following brief abstract is made.

The *time* of the shock at Topeka, Kansas, was about fifteen minutes to three o'clock. At the Agricultural College, Manhattan, it is noted as having occurred at thirty-two minutes past two o'clock. At the State University, Lawrence, it is reported to have occurred at about three minutes to three o'clock by the town clock, which is generally a little fast. Making allowance for different meridians the time of occurrence was later as we go eastward.

The *duration* of the shock was from ten to thirty seconds. In western Kansas it was about ten seconds in length, but gradually increased to thirty seconds or more in its progress eastward.

The *direction* of the shock appeared to be from the south or southwest to the north or northeast. This is shown from various facts, the principal one being the movement of the water in the Kansas river. At Manhattan the water of this river was observed to roll in a heavy wave, at least two feet high from the southerly to the northerly bank, while no similar movement was noticed in the Big Blue which empties into the Kansas river from the north at the same place. This fact has been thoroughly substantiated by Prof. Mudge of the State Agricultural College. It rests upon the testimony of several credible witnesses and is decisive. In confirmation of the same, light articles, such as photographs, when piled upon each other, were pitched over toward the southwest. Waves in the ceiling of Lincoln College were observed to run from the southwest toward the northeast. Rev. R. D. Parker, attending the dedication of a church at Warrensburg, Missouri, at the time, observed the walls of the church heave as if moved by a shock from the southwest.

The *number* of shocks seemed to vary in different places. At the initial point in western Kansas, or eastern Colorado, there seems to have been one shock increasing in intensity and gradually dying away. As the movement progressed eastward the original impulse seems to have separated into two distinct earth waves, which again appear to have faded into each other as they became less violent.

The *movement* of the earth-wave was mainly that of translation. The slight damage done by the earthquake, otherwise so violent and extensive, is probably due to this fact.

The *velocity* of the movement of the earth-wave was great. This is shown by the small difference of time elapsing between the occurrence of the shock at comparatively remote points. The telegraph operator at Topeka, on the Pacific line, states that reports of its occurrence seemed to come indiscriminately immediately after the shock, both from the west and the east.

The *effects* of the earthquake as already indicated, were alarming but not serious. Several persons were more or less injured, but not a life is known to have been lost. Two contiguous blocks in Leavenworth are reported to have been lifted up and separated several inches, but they settled back again apparently uninjured on

the passage of the earth-wave. Two large stones were loosened from the top of the Unitarian church in Lawrence and precipitated to the ground, and the walls of many buildings in different places were cracked, but not one is known to have been thrown down. At Topeka, a funeral service was occurring in one of the churches which was crowded to overflowing. As the stone building was rocked to and fro, the people made a hasty escape in every available direction, many of them jumping through the broken windows. An acre of ground three miles south of Carthage on the Miami canal, is reported to have sunk ten feet, showing that the shock extended to Ohio. The ground sunk bodily, leaving a perpendicular wall of ten feet or more on all sides. The canal bank was seriously endangered by the subsidence.

2. *On the Volcanic eruption near the city of Leon;* by Hon. A. B. Dickerson, United States Minister to Nicaragua, dated Leon, Dec. 4, 1867, (from a letter addressed to the Secretary of State, Washington).—On the 14th of November last a new volcano broke out in Nicaragua, about eight leagues to the east of the city of Leon, on a crowded line of volcanos running through the State parallel to the Pacific coast.

It commenced about one o'clock in the morning with a succession of explosions, which were distinctly felt and heard at Leon. These explosions opened a fissure through the earth crust about half a mile in length, running from the old fissure in a southwest direction, about midway between the extinct volcanos of Las Pilas and Orota, which are two of the numerous cones studding the ancient fissures.

Before daylight on the morning of the 14th, fire was seen issuing from the new volcano in various places. The explosions continued irregularly during the whole time that the volcano was in a state of eruption, sometimes in rapid succession, and at other times at intervals of half an hour. Low, rumbling sounds were heard almost incessantly. In the course of a few days two craters were opened on the new fissure, about a thousand feet apart, the one at the southwestern extremity discharging perpendicularly, and the other shooting out toward the northeast at an angle of forty-five degrees. The flames [?] from these two craters increased in size and height, while jets of flame and slighter discharges were emitted from two or three other side fissures.

On the morning of Nov. 22d, I went to the new volcano for the purpose of observing it more closely, though I had seen and heard it every day and night from Leon. The best view I obtained of it on that occasion was just before daylight from a mountain summit, about one mile to the northeast of the fissures and at right angles with it. The main crater at the right was actively at work throwing out flames and half-melted cinders through a circular orifice about sixty feet in diameter, which was constantly filled to its utmost capacity with the ascending masses. A regular cone, built up entirely by the falling cinders to the height of about 200 feet, had already formed around the crater.

The rim of the cone was white with heat, and the outside was

red hot for half way down, while the remainder of its background work was glittering with innumerable glowing sparks. It was puffing quite regularly about once a second with a strong, constant blast, which kept up a column of flame filled with flying cinders, to the height of about 500 feet above the mouth of the orifice. Irregular explosions occurred at intervals, varying from ten to thirty minutes, increasing the force and volume of the discharges, and sending them far up into the rolling clouds above. The cinders went up in half-fused blazing masses, from one to three feet in diameter, and came down upon the cone hardened, striking with a clinking metallic sound. After daylight the red appearance of the cone changed to bluish-black. The left-hand crater was shooting out oblique discharges of flame of a similar character at an angle of forty-five degrees from the other, and evidently communicated with it about a thousand feet below the surface, the two craters being that distance apart and both discharging simultaneously. The half horizontal crater was about twenty feet in diameter.

On the afternoon of the 27th, after a series of explosions which seemed to shake the earth to its center, the volcano commenced discharging vast quantities of black sand and heavier rocks. The column of flame at night was considerably increased in height, and bright meteor-like spots were seen ascending in the flames to the height of not less than 3,000 feet. These were large spherical stones four and five feet in diameter. The next morning the streets and house-tops were covered with fine black sand from the volcano, and a vast luminous cloud of raining sand overspread the whole surrounding country. The rain of sand continued until the morning of the 30th, when the volcano died away, apparently exhausted by its eruptions. The sand now covers the whole surrounding country from the volcano to the Pacific, a distance of more than fifty miles from it. At Leon it is from an eighth to a quarter of an inch in depth. As we approach the volcano it gradually grows deeper and coarser. For a mile around the crater it lies in particles from three-eighths to half an inch in diameter and about a foot in depth. Still nearer to the cone the sand increases to several feet in depth, and the particles gradually increase in size until they become small broken rocks. About the base of the cone round heavy rocks from four to five feet in diameter lie thickly scattered, but much the larger portion of them are broken into fragments. The cone itself is 200 feet in height, with a crater in the top 200 feet in diameter and about the same number in depth. The inside of the crater, as well as the outside, is covered with hard broken rocks, generally less than a foot in diameter. A long ridge of black scoria leads out from the branch crater in a northeasterly direction. The slaggy lava-like scoria which first issued from the main crater is now principally covered up by the hard igneous rocks which came out from the profounder depths with the last discharges. The forest for leagues around is scarred and maimed by the sharp-cutting storms of sand, and near the volcano the trees lie cut

into numerous fragments, half buried under the sand and rocks. The volcano was an active and interesting sight for 16 days, and now in its repose affords an ample and instructive field for the geologist. Indeed, no country in the world presents a more interesting study than the plain of Leon. Twenty volcanic cones are seen rising from it at a single view. Its soil is unequaled in fertility, as finely pulverized and as evenly distributed as that of the valley of the Nile or the Mississippi; not, however, by water, but by fire! It has literally rained down from the volcanos, richly freighted with fertilizing materials.

Humboldt regretted before his death that men of science had not more fully investigated this remarkable region of country, and it is sincerely to be hoped that it may not much longer remain neglected by them.

The recent fall of sand has been followed by a shower of rain, and though a few days have since elapsed, corn, cotton and grass have grown more rapidly under its fertilizing influence than I have ever seen plants grow before. Some weeds and plants it kills; others it starts forth with renewed life and vigor.

I send herewith a specimen of the sand gathered at Leon before the rain, hoping that it may be analyzed. [The sand consists of grains of scoria, chrysolite and a feldspar].

It may be proper in this connection to call attention to the recent destructive storms, earthquakes and eruptions which occurred in and around the island of St. Thomas during the same period of time which I have been describing, and which undoubtedly sprang from the same general cause, as those earthquakes were distinctly felt at Leon.

2. *Earthquake at St. Thomas.* (1.) From Commodore Bissell's official Report to Rear Admiral J. S. Palmer, of the loss of the United States Steamer Monongahela, dated United States Steamship Monongahela, St. Croix, Nov. 21, 1867.—I have to state, with deep regret, that the United States steamship Monongahela, under my command, is now lying on the beach in front of the town of Frederickstadt, St. Croix, where she was thrown by the most fatal earthquake ever known here. The shock occurred at 3 o'clock P. M. of the 18th inst. Up to that moment the weather was serene, and no indication of a change showed by the barometer, which stood at 30 degrees 15 minutes. The first indication we had of the earthquake was a violent trembling of the ship, resembling the blowing off of steam. This lasted some thirty seconds, and immediately afterward the water was observed to be receding rapidly from the beach. In a moment the current was changed and bore the ship toward the beach, carrying out the entire cable and drawing the bolts from the kelson, without the slightest effect in checking her terrific speed toward the beach. Another anchor was ordered to be let go, but in a few seconds she was in too shoal water for this to avail. When within a few yards of the beach the reflux of the water checked her speed for a moment, a light breeze from the land gave me a momentary hope that the jib and foretopmast

staysail might pay her head off shore, so that in the reflux of the wave she might reach waters sufficiently deep to float her, and then be brought up by the other anchor. These sails were immediately set, and she paid off so as to bring her broadside to the beach. When the sea returned in the form of a wall of water twenty-five or thirty feet high, it carried us over the warehouses into the first street of the town. This wave in receding took her back toward the beach, and left her nearly perpendicular on the edge of a coral reef, where she has now keeled over to an angle of fifteen degrees.

All this was the work of a few moments only, and soon after the waters of the bay subsided into their naturally tranquil state, leaving us high and dry upon the beach. Providentially only four men were lost: these were in the boats at the time the shock commenced. * * * * * Persons looking at the ship from shore declare that the bottom of the bay was visible where there was before, and is now, forty fathoms of water.

(2.) Communication to the Secretary of State from Otto Frederick Raupach, of St. Thomas, dated Dec. 28th, states the following facts as introductory to a full list of all the shocks, with their time of occurrenee.

The 18th of November was a beautiful clear day, with a fine blue West India sky. The wind was east-by-north, but there was very little of it. The ocean was quiet; there was almost a calm. The sun shone bright and warm, and the barometer stood at 24° Reaumur, in the shade. There was not the least sign of any kind to foretell this great convulsion in nature, when suddenly, at about a quarter of 3 o'clock in the afternoon, there was heard an underground rumbling noise, which was immediately followed by a terrific earthquake, which seemed to come from south-by-west, and pass on to the north-by-east. The earth seemed as if composed of small waves rising and sinking under your feet, so that if you made a step forward, your foot seemed to meet higher ground, and if you put it backward it also there met higher ground. To stand still in one spot was impossible, and when trying to walk it was as if something kept you back. The underground sound, while the first shock was going on, for about one minute and a half, was most dreadful. It terrified every living soul. The sun seemed at once to become dim; it was as if eclipsed, and this dimness lasted that first day until sunset, and continued the whole of the next day, but in a less degree, and it only wore away entirely in the course of two days more. It was as if the sun, though apparently as bright as usual, had lost some of its warming and illuminating power. After the first terrific shock the ground continued groaning and trembling, when, about ten minutes after, a second strong shock was felt. Directly after this second shock the ocean, which shortly before the first shock had receded from the land several hundred feet, was seen to rise like one huge wave and come in toward the harbor. It stood up like a straight white wall, about from fifteen to twenty feet high, and advanced very fast into the harbor, sweeping or upsetting small vessels before it, and raising the large men-of-war and steamers to its top. The appearance of

this wave was like a white masonry wall, erect and straight as if built with the aid of a rule; it had not the appearance of ordinary waves. It broke in over the lower parts of the town to the height of a couple of feet and to the extent of about two hundred and fifty feet inland, according to the level of the locality. The rising of the waves was repeated a second time after an interval of about ten minutes, and the second appeared to be even a little larger than the first, and went a little further inland. After these two waves had passed away, the ocean remained, as far as the eye could see, quite calm again, just as it was before the first shock of the earthquake had occurred.

The shocks continued and were felt every few minutes. It was as if the shocks of the first day hung together in one chain, but from 2 : 45 o'clock on the morning of the 19th of November, the shocks were felt more separately and distinct, and, therefore, seemed as if they were more frequent.

From 2:45 o'clock P. M. on the 18th till 2:45 o'clock A. M. on the 19th, there were eighty-nine shocks. From 2:45 o'clock A. M. on the 19th till midnight, there were two hundred and thirty-eight shocks. The shocks became less severe from the 21st of November.

3. *Earthquake in Western New York, Vermont and Lower Canada.*—On the morning of Wednesday, the 18th of December last, at about 3 o'clock, a severe shock of earthquake was felt at Montreal, Burlington and other places in Vermont, and over a distance of 400 miles to the west. The shock is stated to have lasted 20 seconds at Burlington, and a minute and a half at Syracuse, N. Y. The shock is described at Syracuse as like a succession of waves from the south to the north. At Hammond, N. Y., the first shock is stated to have occurred at 10 minutes before 3, others lighter followed; and at 4:27 was the final one, which was quite severe. It shook down crockery, and frightened many persons, but did no serious damage.

4. *Corrections to a paper "on the Comparative Strength of Cannon of modern construction,"* published in the VIIth volume of the Proceedings of the Academy; by DANIEL TREADWELL. (Extr. Proceedings Amer. Academy of Arts and Sciences, for Oct. 8, 1867).—In a paper "On the Comparative Strength of Cannon of Modern Construction," written by me in January, 1866, communicated to the Academy in September of the same year, and published in the last volume (the seventh) of our "Proceedings," I, by some inadvertence for which I am now unable to account, in computing the force of the 600 pounder, or 13·3 inch, coil gun, as constructed by Armstrong, described it as capable of bearing a charge of 100 pounds of powder.

Although this quantity of powder was no doubt fired in it, I know not how many times, yet it ought not by any means to be rated as its *service charge;* and I recognize it as an oversight in me to have taken it as such. In fact, I have no belief, that more than 70 pounds of powder should be assigned as the service charge of the Armstrong 13·3 inch gun; as no gun can be trusted for

long continued firing with more than $\frac{70}{100}$ of the largest charge of powder which it may have withstood, and no *cast-iron* gun with so much as this.

I have not the data necessary to determine accurately the velocity, and consequently the force, which this reduction of the charge of powder must make in the shot; but if we take the force of the shot in the direct ratio of the weight of the charge of powder we shall have 261, instead of 372·8, as representing the "number of pounds of shot raised one foot by each pound of metal in the gun," as these numbers are in the ratio of 70 to 100.

I am not able to state what has constituted the greatest charge of powder borne by Armstrong's gun of 12 tons, carrying a shot of 300 pounds; but, reducing the charge of 60 pounds, as given by me, in the ratio of 70 to 100, we have a charge of 42 instead of 60 pounds of powder, and a consequent reduction of the force of the gun from 392 "foot pounds" to 273 "foot pounds."

I have thought it the more necessary to make this correction, as in a computation of the force of the Dahlgren & Rodman guns given in the same paper to which this is a correction, the quantity of powder then understood by me from all that had been published by government authority as constituting a service charge was taken as one of the factors in assigning the measure of the force to those guns. It is now claimed, however, to have been discovered that the Rodman gun is capable of withstanding much larger charges of powder than were authorized to be used when my paper was communicated to the Academy.

5. *Cretaceous Coal in New Mexico.*—In a letter from Prof. JOHN LECONTE, dated Fort Craig, New Mexico, Oct. 3d, 1867, he states that through the facilities afforded him by General W. W. Wright, Chief Engineer of the eastern division of the Union Pacific Railroad, he has been enabled to make an examination, and determine the age of the bed of anthracite near the Old Placer Mountain, twenty-five miles southwest of Santa Fe. Dr. LeConte has forwarded to us specimens of the anthracite and also of the unmetamorphosed coal from the coal mine eight miles east of San Antoino and the Rio Grande. He has determined by his investigations that they both belong to the older Cretaceous period, and are the same lignites mentioned by Dr. Newberry (Rept. Ives' Expedition) and Dr. Parry (Rept. U. S. Boundary Survey) as occurring in other localities in the Rio Grande valley. Dr. LeConte remarks, however, that the locality near the Placer Mountain is the only place in which this Cretaceous coal has been converted into anthracite, and that the cause of the metamorphosis is a stream of lava which has flowed over the rocks containing the coal bed, and has congealed into gray trachyte. The Cretaceous rocks dip nearly 30° in an easterly direction and the cleavage of the anthracite is vertical, bearing south. About a third of a mile from the anthracite locality is another exposure of the same vein in which the coal is much less altered from its original condition.

6. *On the introduction into the Mohawk River and Erie Canal of certain species of Shells not previously found in those waters.* (Extract from a letter from Dr. J. Lewis of Mohawk, addressed to the Smithsonian Institution).—"For the benefit of future collectors, I would like to have recorded, that in the month of October and November, 1867, I placed in the Erie canal, and the Mohawk river at this place, several hundred living specimens of the Molluscs Mr. Binney calls *Vivipara contectoides*. A large share of these were placed in a wide and deep portion of the canal, nearly a mile east of the central part of the village of Mohawk, a few rods east of a point against which there has been a "*land slide*" from the adjacent bluff. A few were placed in the canal above the "upper lock and aqueduct" at Mohawk. In both instances near the south bank of the canal. A considerable number were placed on the south side of a wide curve in the river, several rods above the mouth of "Fulmer's Creek." These were distributed along the *muddy slope* in water about 3 to 4 feet deep, for a space of about five rods, the adjoining land belonging to Ezekiel Spencer, Esq. The western limits of distribution is near the center of the northern boundary of Mr. Spencer's lands.

At this place, also, were placed in the river a number of specimens of the shell Mr. Lea calls *Tryperastinia Lewisii*. These shells were sent to me from the *Illinois river* for this purpose, by Mr. John Wolf, of Canton, Illinois.

I have hopes that this effort to colonize these species will prove successful, as they were all apparently healthy and active. A limited number of specimens of Vivipara were examined and found to contain embryonic young in various stages of development, but none ready for exclusion. Forty young, and over, were taken from one specimen an inch long. Other Molluscs have been solicited for similar experiments. Reports will be made when they are colonized.—(*Communicated by Prof. Henry.*)

7. *Observations on the transfer of the Library of the Smithsonian Institution to the Library of Congress;* by Professor Henry. (From the unpublished Report of the Secretary of the Smithsonian Institution for 1866).—Although the present condition of the fund is a matter of congratulation, yet there is another fact belonging to the history of 1866 of equal if not greater importance, in regard to the future efficiency of the Institution. I allude to the transfer of the Smithson library for safe-keeping and support to the Library of Congress. To those who have not fully considered the subject, it might, at first sight, appear that this transfer of a large number of rare and valuable books from the building of the Institution would be attended with serious inconveniences, and be a virtual relinquishment of the control of property procured at the expense of the Smithsonian fund. But it will be evident, on a statement of the facts, that the advantages accruing to the Institution and the public from the transfer far outweigh any inconvenience which may arise on account of it; and that it will tend to increase the efficiency of the funds, while it adds to the security and even facilitates the general use of the library.

Although the removal of the books renders them somewhat less accessible to those engaged in study and researches at the Institution, yet all the current transactions of the scientific societies of the world, which constitute the principal part of the library, will be still received at the Institution. An opportunity is thus afforded of noting their contents before they are sent to the Capital, and such books will permanently be retained as are of most constant reference. In addition to this, the Institution is to have at all times, the free use of the books of the Congressional library as well as those of its own, and for this purpose, and the better accomodation of the public, the library of Congress is to be open throughout the year, with the exception of a month for cleaning and examination. Hence the general student, instead of being debarred any important privilege, will find increased facility for research in having access, in the same building, to both libraries. Again, the east wing of the Smithsonian building, in which the books were deposited, is not fire-proof, and is liable to destruction by accident, or the torch of the incendiary, while the rooms of the Capitol are of incombustible materials. This wing was, moreover, filled to overflowing, and a more extended and secure depository could not be obtained, except by another large draught on the accumulated funds intended to form part of the permanent capital. Besides this, by the terms of the transfer, the cost of the care, binding, and cataloguing of the Smithsonian books is provided by government, and an important part of the annual income of the Institution is thus saved for other purposes.

But the advantages of the transfer are not confined to the Institution. The library of Congress has secured such an addition as cannot be obtained by purchase, since many of the books are presents from the duplicates of the old libraries of Europe, consisting of transaction and other publications of the learned societies of the world, forming a special collection, not only ranking as first in this country, but one of the best anywhere in existence. Neither is it alone the value of the books that have actually been transferred which is to be considered, but also the means which are offered, through our system of exchange, for the perpetual increase of the several series of works which contain the record of the actual progress of the world in all that essentially pertains to the mental and physical development of the human family. The transfer of the Smithson library has furthermore tended to awaken an interest in the library of Congress, which cannot fail, under the energetic superintendence of the present librarian, Mr. Spofford, in a few years to render it worthy of the national Capitol. An appropriation of $100,000 has been recommended* by the Joint Committee of the two houses of Congress for the purchase of the library of Mr. Peter Force, consisting of books relative to America. With these additions the library of Congress will be the largest in the United States, and the necessity of a separate building is even already foreshadowed.

* An act has been passed in accordance with this recommendation, and the library of Mr. Force is now the property of the Government.

But above all, the act authorizing the reception, care and support of the Smithson library may be considered as an approval by Congress of the general policy adopted and the course pursued by the Institution. It will be recollected that at the commencement a number of influential literary men warmly advocated the expenditure of the larger portion of the income of the Smithson fund in the establishment and support of a library. This plan was opposed on the ground that the Institution by the terms of the bequest should be of a cosmopolitan character, and produce results, the benefits of which would not be confined to one city, nor even one country, and which could not be accomplished by a library. The act of organization, however, was so expressed as to give color to the idea that a large library was intended by Congress, and much complaint was at one time made because more of the income was not expended in the purchase of books. The late legislation of Congress will leave no ground for further cavil in regard to this point, and while the Institution will be relieved from a large expenditure on account of the library, a national collection of books will be formed far more extensive than could possibly be supported by the Smithsonian fund.

Moreover, while thus relieving the Institution from a charge which has borne so heavily on its resources, Congress has afforded most encouraging evidence of an important advance in public opinion regarding the right interpretation of the terms of the Smithson bequest. It is substantially a recognition by the national legislature of the fact that the Smithson fund ought not to be burdened with the support of objects which, while they absorb the income, are locally restricted in their influence, and neither essentially connected with the design, nor authorized by the language of the trust. Since Congress has eventually thought proper to assume the care of the library we may cherish the hope that in due time it will also make provision for the separate maintenance of a collection of objects of "nature and art," not unworthy of the National Capital; and that the proceeds of a fund, now generally recognized as having been intended by the testator for objects of a higher order than those confined to local or even national benefit, will be entirely devoted to the system of operations which an experience of twenty years has abundantly shown to be the best and most practical means of realizing the design of the testator.

The propriety of making provision for the separate maintenance of a national museum, and of relieving the Smithson fund from the burden imposed upon it in this way, will be evident when the fact is recalled that the plan of the present expensive building was adopted to accommodate the museum of the Wilkes' exploring expedition, the care of which had been devolved upon the Institution by the law of Congress. But the Board of Regents, after the building was completed, decided that the keeping of this museum ought not to be a charge on the Smithson fund, and before assuming the care of it asked an appropriation, at least equal to

the cost of keeping the articles, while in the Patent Office. Congress recognized the propriety of this position, complied with the request, and has appropriated since the transfer, annually, $4,000. This sum, however, has not sufficed to defray the cost of attendance, even during the period of low prices previous to the war, without allowing for any increase in the number of articles, or for the interest of the money expended on the building.

It is highly gratifying to observe that a more liberal spirit at present exists. Congress has recently made provision, on an ample scale, for the accommodation of an Army Anatomical Museum, and for a Museum connected with the Agricultural Department, and it can scarcely be doubted, that on a proper presentation of the subject, the same enlightened consideration which prompted the appropriations for these kindred objects, will also induce Congress either to appropriate the Smithsonian building to the use of a National museum, under a separate organization and endowment, or else to make an annual grant of money, which, expended under the direction of the Board of Regents, shall be sufficient properly to support an establishment of this kind.

The reconstruction of the building has been carried on during the past year as rapidly as the funds at command and a due regard to the character of the work would allow. The considerations which have governed the building committee have been to render the work entirely stable in regard to materials and construction, and thoroughly fire-proof, first completing such parts as were necessary for the safety of the structure, and next those most wanted for use in the operations of the establishment.

One of the most important points to be determined during the year was the kind of roof to be adopted for the main building, and, after full inquiry, the preference was given to one, consisting of an iron frame with slate covering. The contract for the iron work was made with the Phœnix Iron Company of Philadelphia, but owing to unexpected delays the frame was not received in time before the setting in of frost to complete the covering with slate. The walls of the large south tower were found in a worse condition than was at first supposed, thirty feet of the height having to be removed and entirely rebuilt, the facing of cut stone being of new material. To secure the front towers and furnish supports for the iron beams and brick arches for the floors, a lining of brick, laid in cement, has been constructed from the bottom to the top. The inner lining of the walls of the upper story of the main building, which was exposed to the fire, has also been entirely renewed with similar materials. The masonry of the whole building is now completed, and it is expected during the next season to finish all the rooms except the main hall over the museum. The future use of this room, which is 200 feet long by 50 feet wide, has not yet been settled. It will not be wanted for the uses of the Institution, and unless devoted to a National Museum or to some other purpose, it would probably remain for an indefinite

time, unfinished. The reconstruction of the building, exclusive of this room, will cost $150,000, and if to this be added the sum previously expended on the erection of the building, we shall have a total of $475,000, of which, at least, $400,000 might have been added to the principal, or expended in the promotion of knowledge.

The superintendence of the work is still under the direction of the architect, Mr. Adolf Cluss, and every part of the construction and all the plans have been critically examined and discussed by General Government.

8. *Porcelain-like glass from Cryolite.*—The various products of the Cryolite industry are briefly stated in volume xxxv (1863) of this Journal. These products are manufactured on a large scale at Natrona, Pennsylvania. And in addition a glass has been made by fusing together sand and cryolite which is a very close and handsome imitation of fine porcelain.

9. *Dr. Livingstone.*—Sir Roderick Murchison in his address before the Geographical Society, cited at page 14, states his firm belief in the safety of Dr. Livingstone. The latest telegram announces that this African traveller is alive and well. Positive advices just received in London leave no doubt as to his safety.

OBITUARY.

10. Dr. JOHN RUGGLES COTTING.—Dr. Cotting died at Milledgeville, Ga., on the 18th of October. He was born in Acton, Mass., in 1784. The following sketch is from the Southern Recorder.

His first fifty years were spent in Massachusetts; his last thirty in the valley of the Oconee, in Georgia, at Milledgeville. Refined by nature and by all the good influences of Harvard and Dartmouth colleges, he perfected his excellent education by several years of professional life in Amherst College, in high schools and in the Berkshire Medical Institute; and besides this, during all these years, he was a settled Congregational minister of the Gospel. In 1835 Dr. Cotting removed South, and was first settled in Augusta, Ga., where he was engaged by some liberal, enlightened gentlemen, all or mostly cotton planters, to make a geological and agricultural survey of Burke and Richland counties. This important work, the first of its kind in Georgia, was done in the year 1836; his map and drawings were deposited in the Medical College of Georgia, at Augusta, and his report, an interesting duodecimo, with his local and geological descriptions, analysis of cotton lands, and a table of fifty-seven genera, embracing a large number, of fossils, was published and submitted to Governor Schley, who laid it before the legislature and urged them to order a similar survey of the state. They adopted his advice, appropriated $10,000 to the service, and Governor Gilmer appointed Dr. Cotting to the office of state geologist. The work was carried on for two years, when owing to financial trouble the legislature withdrew the appropriation, and the survey ceased. During its progress, Dr. Cotting collected in the eastern counties of the state, and in the extreme southwest county, Decatur, a rich herbarium of our

peculiar flora, and a cabinet of our fossils and minerals, of wide scientific interest. Unfortunately for the cause of science his collection was distributed among the colleges or otherwise disposed of, and the results of his labors are lost.

11. Lord Rosse, the Astronomer, died Oct. 31, aged 67 years.

IV. MISCELLANEOUS BIBLIOGRAPHY.

1. *Colton's Journal of Geography and Collateral Sciences:* a record of Discovery, Exploration, and Survey, issued quarterly from Colton's Geographical establishment. 16 pp. 8vo. $1 a year. New York, Oct., 1867. Number 1.—Messrs. G. W. & C. B. Colton, who are well known as the publishers of Colton's Atlas and other American maps, have commenced the publication of a "Journal of Geography and Collateral Sciences." It is to be published as a record of discovery, exploration and survey. The first number contains a summary of what is known in respect to Alaska, illustrated by a map of the Territory, including the numerous appertinent islands; and also the earlier portion of a paper by Prof. J. D. Dana, on "the plan of development in the Geological History of North America," which was read before the American Association in 1856, and is illustrated by a map of the world, on Mercator's projection. The Journal also contains a selection of items pertaining to recent discoveries and investigations on different parts of the globe.

The publishers are very modest in the announcement of their plans,—but they show a good spirit, and we trust that they will receive sufficient encouragement in their undertaking to warrant its continuance. If they will bring together merely the results of American researches and surveys, with carefully prepared maps, they will render a good service to scientific readers. The first number is dated October, 1867; the second has not yet reached us.

2. *The Cambridge course of Elementary Physics.* Part First. *Cohesion, Adhesion, Chemical affinity, and Electricity.* By W. J. Rolfe and J. A. Gillet, Teachers in the High School, Cambridge, Mass. Boston, Crosby & Ainsworth, 1868. 12mo, pp. vi, 324.—This book aims to be a collection of leading principles, rather than a mere compilation of facts. The molecular attractions, cohesion and adhesion, are very well treated from the modern stand-point. The chemical part follows in the main, the order of Hofmann's modern chemistry. The new notation is used, but joined to the ill-fitting nomenclature of the old. Facts too, are rather scarce; the student ought to have the properties of the principal elements more fully stated, to enable him to understand the more practical parts of the section, such as the growth of plants, the manufacture of sulphuric acid, soda-ash, etc. The subject of electricity is very well presented. An excellent summary of the contents of each section is given at its close, and chemical problems are introduced where needed. Greater precision of language would be desirable, however, in some instances; as when it is said "The particles into which a solid is resolved when it melts, and a liquid when it boils,

are called *molecules*"; and again when chemical affinity is defined as "that force which causes the elements to combine." Moreover the equation $Na_2O+H_2SO_4=HNaO+HNaSO_4$ is hardly admissible. We think that the book will serve a good purpose nevertheless, and commend it to the attention of teachers.

3. *The Cambridge course of Elementary Physics:* Part Third, *Astronomy*, by W. J. ROLFE and J. A. GILLETT, Teachers in the High School, Cambridge, Mass. 308 pp. 12mo, with numerous illustrations. Boston, 1868. (Crosby & Ainsworth, Boston; O. S. Felt, New York.)—This little volume is intended as a popular introduction to Astronomy for High Schools and Academies, and appears to be well adapted to its purpose. The abstruse mathematics of the subject are not touched upon; while the principles are succinctly and clearly explained and illustrated by excellent wood cuts. The cuts of the nebulæ, of the Moon's surface, and the surface of some of the planets, have hardly been excelled as wood engravings. The volume closes with "Questions for review and examination."

4. *Akademische Denkreden*, von Dr. CARL FR. PH. V. MARTIUS, Mitgliede der K. Bayer. Akademie der Wissenschaften, und Secretaer der Mathemat.-Physical. Classe. Leipzig, 1866. pp. 619.—At various times, during many years past, Dr. Von Martius has been called upon to present to the Academy above named, biographical or memorial notices of members recently deceased, a work he was peculiarly fitted to perform. He has now collected the papers into the volume before us, making a valuable collection of forty-four biographical notices, some of which have appeared before, others not, but all have been revised or amended, where this has been deemed advisable. We have here pleasant sketches of the lives of many of the men who have been especially eminent in science in Europe, who have died during the last thirty years or more.

5. *Physical Geography;* by Prof. D. T. ANSTED, M.A., F.R.S., &c. 468 pp. 12mo. Philadelphia, 1867. (J. B. Lippincott & Co. —Prof. Ansted's work on Physical Geography gives an interesting and popular view of the features and physical phenomena of the globe. It is full in facts, for a work of the size, more so than probably most teachers would desire, and less well supplied than it might be with comprehensive views of the arrangements of the earth's surface. The author sees no objection to the Darwinian hypothesis.

6. *Report of the Superintendent of the U. S. Coast Survey, showing the Progress of the Survey during the year* 1865. 232 pp. 4to, with 31 large plates, mostly maps.—The health of Dr. Bache, the Superintendent of the Coast Survey was already much impaired, when the Report for 1865 was called for, and the work of its preparation consequently devolved on the able Assistant in charge, J. E. Hilgard. This volume is especially rich in its maps.

7. *Chambers's Encyclopedia*, A Dictionary of Universal Knowledge for the People, on the basis of the latest edition of the German Conversations Lexicon. Illustrated by wood engravings and maps. The American reprint by J. B. Lippincott & Co., of Phil-

adelphia, of this valuable and popular Encyclopedia has been issued to Part 119 inclusive, which closes volume IX, and carries the work half through the letter V.

8. *The Chemical News.*—The American reprint of the Chemical News, has now become a true transcript of the original work, and we commend it to the American public.

Proceedings of the American Association for the Advancement of Science. Fifteenth meeting, held at Buffalo, N. Y., Aug. 1866. 130 pp. 8vo. Published by Joseph Lovering, Permanent Secretary, Cambridge, 1867.

Report of the Calcutta Cyclone of October, 1864, by Lieut. Col. J. E. Gastrett and Henry F. Blanford, A.R.S.M., with Maps and Diagrams illustrating the origin and progress of the storm and the track of the storm wave. Printed and published for the government of Bengal, by order of the Lieutenant Governor. Calcutta, 1866. A very valuable report, with a complete survey of the facts in their various relations.

PROCEEDINGS BOSTON SOC. NAT. HIST., vol. xi.—p. 132, On Diatomaceous mud from Pleasant Beach, Cohasset; *C. Stodder.*—p. 136, Method of stimulating union between insects of different species; *L. Trouvelot.*—p. 141, Rocks in Nature and in the Arts; *A. L. Fleury.*—p. 151, Meteorology of Cape Flattery, Washington Territory; *J. G. Swan.*—p.161, Annual Report.

PROCEEDINGS ACAD. NAT. SCI., PHILADELPHIA, No. 3, June, July, Aug., Sept., 1867.—p. 81, Five new species of Unionidæ and one Paludina of the U. S.; *I. Lea.*—A new genus of Plants; *A. Wood.*—p. 83, Spiral duct in Salisburia adantifolia; *H. C. Wood, Jr.*—p. 85, Remarks on a fossil ox skull from San Francisco, Cal.; *J. Leidy.*—Reptiles from Owen's Valley, Cal.; *E. D. Cope.*—p. 86, Certain doubtful minerals; *F. A. Genth.*—p. 87, Necessity and Velocity of Nebular Rotation; *J. Ennis.*—p. 94, On certain Birds from New Granada, with descriptions of new species; *G. N. Lawrence.*—p. 95, A new genus of Cyprinoid fishes from Va.; *E. D. Cope.*—p. 98, Note on Dioicous forms of Vitis vinifera L.; *T. Mechan.*—p. 99, New species of Owl, of the genus Scops; *D. G. Elliot.*—p. 100, A study of the Rhamphastidæ; *J. Cassin.*

PROCEEDINGS OF THE ESSEX INSTITUTE, Salem, Mass. Vol. v, No. 4.—p. 97, Observations on Polyzoa; *A. Hyatt.*—p. 113, Flora of the Hawaiian Ils.; *H. Mann.*—Naturalists' Directory, pp. 33–40, Botany, Archæology, Ethnology. General Zoology, Mammals, Birds.

TRANSACTIONS OF THE AMERICAN ENTOMOLOGICAL SOC. Vol. i, No. 2.—p. 151, Descriptions of new Pseudomorpha from Cal., with Notes on the Pseudomorphidæ; *G. H. Horn.*—p. 159, Notes of the Zopheri of the U. S.; *G. H. Horn.*—p. 171, Descriptions of American Lepidoptera; *A. R. Grote* and *C. T. Robinson.*—p. 193, Catalogue of the described Tenthredinidæ and Uroceridæ of North America; *E. Norton.*

PROCEEDINGS OF THE CALIFORNIA ACAD. NAT. SCI., Vol. iii.—p. 314, On the Nourishment of the Fœtus in the Embiotocoid Fishes; *J. Blake.*—p. 317, The Pines of Cal.; *Bolander.*—p. 319, The fresh water Infusorial Deposits of the Pacific Coast, and their connection with the Volcanic rocks; *J. D. Whitney.*—p. 325, Fossil Elephant's Teeth from the Northwest Coast; *W. P. Blake.*—p. 326, "Which is the highest mountain in the U. S., and which in N. A.?"; *J. D. Whitney.*—p. 328, Remarkable Instance of Vitality in a Snail; *Stearns.*—p. 329, A. Wood's Botanical collections in Cal.; *Bolander.*—p. 331, West coast Helicoid Land Shells; *J. G. Cooper.*—p. 339, Origin of the Submerged Forests in the Columbia River; *W. P. Blake.*—p. 342 Analysis of two ores from the Comstock Lode, Nevada; *Domeyko.*—p. 343, Shells collected at Santa Barbara; *R. E. C. Stearns.*—p. 345, List of Shells collected at Parissima and Lobitas, Cal.; *R. E. C. Stearns.*—p. 347, Note on the Brown Coal Formation of Washington Ter. and Oregon; *W. P. Blake.*—p. 348, Analysis of Mt. Diablo (Cal.) Coal; *W. P. Blake.*—p. 349, Peculiar mode of occurrence of Gold and Silver in the Foot-Hills of the Sierra Nevada; *B. Silliman.*—p. 353, A new species of Pisidium; *J. Rowell.*—p. 353, Exhibition of Parhelia; *R. E. C. Stearns.*—p. 354, New locality of Diamonds in Cal.; *B. Silliman.*—p. 355, The Geological position of Coal; *J. D. Whitney.*—p. 359, Geological features of Peru; *Antonio Raimondi.*